Under the heading " Distribution " the range of each species is given, followed by a general statement for British Columbia and including a selected list of localities from which specimens have been collected. A map of the Province is provided for reference on the back of the fly-leaf.

STRUCTURE

While bivalve molluscs have certain basic anatomical characteristics common to all, many variations in structure make some members scarcely recognizable as molluscs. The following account of lamellibranch structure is very generalized without all the infinite variations.

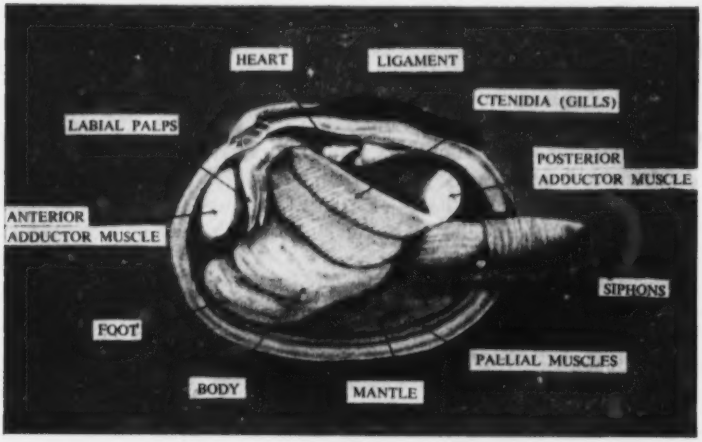

Fig. 1. Clam with left valve removed.

Shell.—Most bivalves have a soft body enclosed or partially enclosed by two hard calcareous shells (Figs. 1 and 3). The shells are chalky structures composed of varying proportions of calcium carbonate, aragonite, and other materials. There are three layers: an inner nacreous layer, that may be quite lustrous; a simple central chalky layer; and a thin outer periostracum which may or may

not be evident. The two shells may be equal or unequal in size and shape. They are normally hinged in the dorsal (back) region either by an internal or external hinge which is arranged to spring the valves open. This tendency is opposed by the adductor muscles, which extend from shell to shell and which determine the extent to which the valves are allowed to gape. When a single adductor muscle is present, it is close to the central area, but where there are two muscles, they are placed fairly close to each end of the shell. Insertions of the adductor muscles and of the pallial muscles usually leave scars on the internal surface of the shells, and shape and position of these scars are often useful identification characteristics (Fig. 3).

Body.—A part of the body is extended into a muscular foot normally used for burrowing. Sedentary (attached) species, such as the oyster, may not have a foot. The body is enclosed in a thin fleshy envelope called the " mantle," which is thickened to form mantle pallial muscles at the edge of the shell. The mantle edge is divided into three lobes; one is sensory, one secretes shell, and another the periostracum. At the posterior end of most bivalves the mantle edge is modified to form two tubes called " siphons " or the " neck."

Respiratory System.—Within the mantle cavity and between the mantle and the soft body, gills, or, more accurately, ctenidia, are attached to the body along the hinge area (Fig. 1). Ctenidia are basket-like organs studded with tiny hair-like structures called " cilia," whose vibrations produce water currents that enter the mantle cavity through definite areas on the edge of the mantle or through the inhalant siphon. The sieve-like structure of the ctenidia together with copious amounts of mucus trap small food organisms, and the through passage of water aerates blood in the tissues.

Digestive System.—Within the main body are various organs of digestion, circulation, and reproduction. Close to the mouth are four gill-like structures, termed " labial palps," which function as food-sorting mechanisms. Normally, there is a short tube or œsophagus leading from the mouth to a sac-like stomach from which extends the long coiled intestine. This usually terminates above

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The Intertidal Bivalves of British Columbia

By D. B. QUAYLE
Provincial Shellfish Laboratory, Ladysmith, B.C.

Illustrations by Frank L. Beebe

VICTORIA, B.C. - - - JULY, 1960

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1960

* Present address: Biological Station, Nanaimo, B.C.

BRITISH COLUMBIA
DISTRIBUTION MAP
BRITISH COLUMBIA PROVINCIAL MUSEUM
Scale of Miles
0 50 100 200
132°
128°
124°
120°
116°
60°
58°
56°
54°
52°
50°
130°
126°
122°
118°
114°
DATLIN
TELEGRAPH CREEK
Cassiar District
Rocky Mountains
Peace River District
ALASKA
PRINCE RUPERT
QUEEN CHARLOTTE ISLANDS
HECATE STRAIT
QUEEN CHARLOTTE SOUND
PACIFIC OCEAN
Fraser River
Cariboo District
PRINCE GEORGE
KAMLOOPS
Kootenay District
Okanagan District
VANCOUVER
NANAIMO
VANCOUVER ISLAND
VICTORIA

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The Intertidal Bivalves of British Columbia

INTRODUCTION

The purpose of this handbook is to provide identification of some common lamellibranch or bivalve molluscs living in the intertidal zone along the British Columbia Coast. Few of these species occur exclusively in this Province, for the range of most of them extends north into Alaska or south into the United States. A considerable number range from Alaska to California, and a few are found throughout the northern hemisphere. Many more species live in deep water below the level of lowest tides, but these may be obtained only by dredging, although occasionally some, such as the scallops, are cast up on the shore after heavy storms.

Some species are very common and are abundant on most beaches along the coast. Others are quite rare or occur only in specialized habitats, such as on the abdomen of mud shrimps or with certain sea worms. Another species is embedded in the tissues of compound ascidians. Little is known of the natural history of most of these molluscs, but where possible this information is given.

Lamellibranchs are very adaptable molluscs; they live in deep and shallow water, salt, brackish, and fresh water, lying loosely on the surface, attached to the surface or burrowing in mud, sand, wood, clay, or stone. Several groups, among which are the scallops, are able to swim.

Illustrations provide the best means of identification as word pictures are unsatisfactory for many bivalve shells. For species discussed in this handbook, a key to the families is given, as in each group there are relatively few species. If the family group of the shell can be determined, in most cases the descriptions and figures are sufficient to identify the species.

Of the numerous classification schemes, the one given here may be found in most reference texts dealing with Pacific Coast shells. Names of molluscs are constantly being changed; therefore, some of those used here may be quite different in other accounts.

the posterior adductor muscle close to the exhalant water current. Also from the stomach leads a short blind tube or sac in which is secreted the crystalline style. This is a gelatinous rod concerned with digestion, but it is often mistaken for a parasitic worm. On both sides of the stomach, and leading into it, is a complicated system of tubules forming the so-called "liver," but more properly termed the "digestive gland." This is usually dark in colour, varying from light brown to dark green, depending on the feeding activity.

Circulatory System.—Just below the hinge area in most species lies the simple heart. The remainder of the circulatory system is not well defined, but there are veins and arteries containing colourless blood. Many of the blood-vessels end in irregularly shaped cavities called "sinuses." The excretory system is small and is difficult to find.

Nervous System.—The nervous system in bivalves is a dispersed one, consisting of three small nerve centres connected by nerve cords. In large clams, nerve centres are small reddish bodies slightly larger than the head of a pin; one is located in the foot, one near the posterior adductor muscle, and another close to the mouth. The whole body and mantle function as sensory organs, although there are some specialized areas. Otocysts are located in the foot; these appear to be associated with orientation and locomotion. The osphradium is a sensory area in the region of the entrance of the water current into the mantle cavity, presumably for testing incoming water. Some species of lamellibranchs, such as scallops (*Pecten*), possess eyes located on the mantle edge. These are able to detect variations in light intensity.

Reproduction.—Like most organs in lamellibranchs, the reproductive bodies are paired and are often associated in position with the kidneys. The reproductive cycle varies from species to species. In oysters the gonads are dormant and reduced in size, except during the summer breeding season. In many clams there is prolonged reproductive activity, and eggs and sperms may be found at most times of the year. Sexes are commonly separate, but some species, such as the cockle, are hermaphroditic. In others the initial sex phase is male, and in some there is a regular alternation

of sexuality, sometimes during the breeding season, as in the case of the native oyster (*Ostrea lurida*); or as in the Pacific oyster (*Crassostrea gigas*) the sex may be changed between breeding seasons.

In most species, fertilization is external with subsequent development of a free-swimming larva which, on reaching a certain size, drops onto or becomes attached to the bottom. In others, fertilization takes place in the mantle cavity, where eggs and larvæ are incubated for a time. In this case the larvæ may, or may not, have a free-swimming period.

Food

The food of most lamellibranchs consists of microscopic living and non-living suspended material in the water. As water is drawn through the ctenidia, food particles are enmeshed in mucus which is carried along certain ciliated tracts to the edge of the ctenidia, where it is transported along a definite food groove to the mouth. Here palps select food mainly on the basis of size. Certain species, such as the tellinids, have modified siphons through which is drawn surface mud from which food is extracted. Another form of specialization is found in the shipworm, which utilizes part of the ingested wood borings.

A TYPICAL LIFE-HISTORY

As with structure, there are numerous variations in mode of life and habitat. A fairly typical life-history of which details are quite well known is that of the Pacific (Japanese) oyster (*Crassostrea gigas*).

In this species there are male and female individuals, although the sex may change from year to year. Each oyster begins to develop sexual products in spring when water temperatures begin to rise, and under normal temperature conditions in most British Columbia waters they are fully ripe by the beginning of July. The sex of the oyster may be determined only by examination of the reproductive tissue. Eggs appear as tiny cream-coloured granules even to the naked eye, while sperm material appears as a pure white, sticky substance. The veined gonad covers both sides of the body. In the spawning act, oysters discharge the sexual products into the surrounding water, where fertilization takes place.

Very soon the young oyster or larva, as it is now called, is able to swim and rapidly develops two fragile shells. Its ability to swim is limited and serves only to assist in keeping it in the upper layers of water. Within a few days the young animal develops a digestive system and a number of other essential organs, such as the velum, which is the specialized mechanism used for swimming and feeding. Food consists of small plants and plant-like animals whose length is about one four-thousandth of an inch. As the larva grows, more and more organs are developed, until at the end of seventeen to twenty days it has most of the organs of the adult oyster and, indeed, some that the adult does not have. For example, an oyster larva has a foot similar to that found in a clam, while the adult oyster does not.

At this time the Pacific oyster larva is approximately one-eightieth of an inch in length and is ready to become attached. In the course of being swept along by currents, the larva may strike a solid object, such as the shell of an older oyster. By means of the ciliated foot it crawls over the shell until it finds a suitable spot. This is often in a niche or cranny, but the most important consideration is that the area be clean and hard. When the young oyster finds a suitable spot, it squeezes from a gland in the foot a tiny pool of cement into which is pushed the left valve. The cement soon hardens, making the young oyster immobile for the remainder of its life, but as the shell grows it may break loose from its original attachment. This cementation process is called "setting" or "spatting," and the young oyster is called a "spat" or a "seed." (Many clams use a thread-like byssus for initial attachment to the substratum, and in some the byssus may persist even in adults.)

Immediately after attachment, the foot, velum, and one of the two adductor muscles of the larval oyster are lost. If food and temperature conditions are suitable, growth is very rapid, and oysters spatted early in summer may be as large as a 25-cent piece when low water temperatures in the fall prevent further growth. Sexual maturity comes early in the Pacific oyster, although it is a function of size rather than age, and if the young oyster is large enough, it may spawn in the first summer after spatting.

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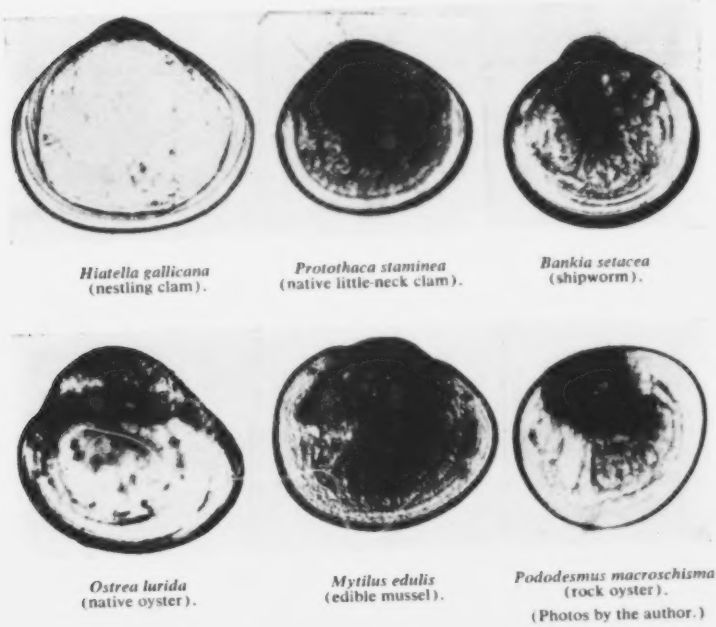
To show variations in shape, the larvæ of several species of lamellibranchs are shown in Fig. 2.



Hiatella gallicana (nestling clam).

Protothaca staminea (native little-neck clam).

Bankia setacea (shipworm).

Ostrea lurida (native oyster).

Mytilus edulis (edible mussel).

Pododesmus macroschisma (rock oyster).

(Photos by the author.)

Fig. 2. Larvæ of some common bivalves (enlarged).

EDIBILITY

As far as is known, all British Columbia lamellibranchs are edible, but some are so small or rare they are seldom eaten. Only a few of the many species are regularly utilized as food.

However, some lamellibranchs are not suitable for food during certain periods of the year. This variation in edibility is generally associated with the sexual cycle and is probably the source of the rule which states that shellfish should be used only during those

months containing an " r " in their name. Since the " r " months are winter months, the " forbidden " time (mainly summer months) coincides with the breeding season of most lamellibranchs, particularly oysters, to which the rule was probably originally applied. In oysters, the oviparous type become laden with spawn during the summer and are soft, with a taste quite unlike that of hard, fat winter oysters. Larviparous types carry larvæ within the mantle cavity for a time, and this habit also renders them unpalatable. For a considerable period after spawning, oysters are very thin and watery and not at all attractive as food, although quite edible.

In clams, the sexual cycle and structure of the gonads are different from those of oysters, and consequently the butter and little-neck clams are at their best when in the spawning condition. Immediately after spawning, normally in the summer months, they are tough, dark in colour, and lacking in flavour.

SHELLFISH TOXICITY

Many people are naturally allergic to shellfish and may become quite ill after eating them. Illness may also result when shellfish are used from polluted waters, or when they have been stored at temperatures not low enough to prevent spoilage.

In addition, at certain periods some species are known to harbour poison that causes a paralysis which may result in death. In British Columbia such species are the butter clam (*Saxidomus giganteus*) and the sea mussel (*Mytilus californianus*). However, it is only rarely that these molluscs become toxic enough in our waters to cause illness and then mainly on beaches close to the open ocean. The source of the toxicity in California has been shown to be a one-celled microscopic organism (*Gonyaulax catenella*) which contains the toxic principal, and when ingested by molluscs, the toxin is concentrated, particularly in the digestive gland, and in the butter clam, also in the siphons.

In 1957 an unexplained abnormal outbreak of shellfish toxicity occurred in Georgia Strait, where oysters also became toxic. However, fishery and health authorities keep a constant check on the presence of toxicity in shellfish and ample warning is given.

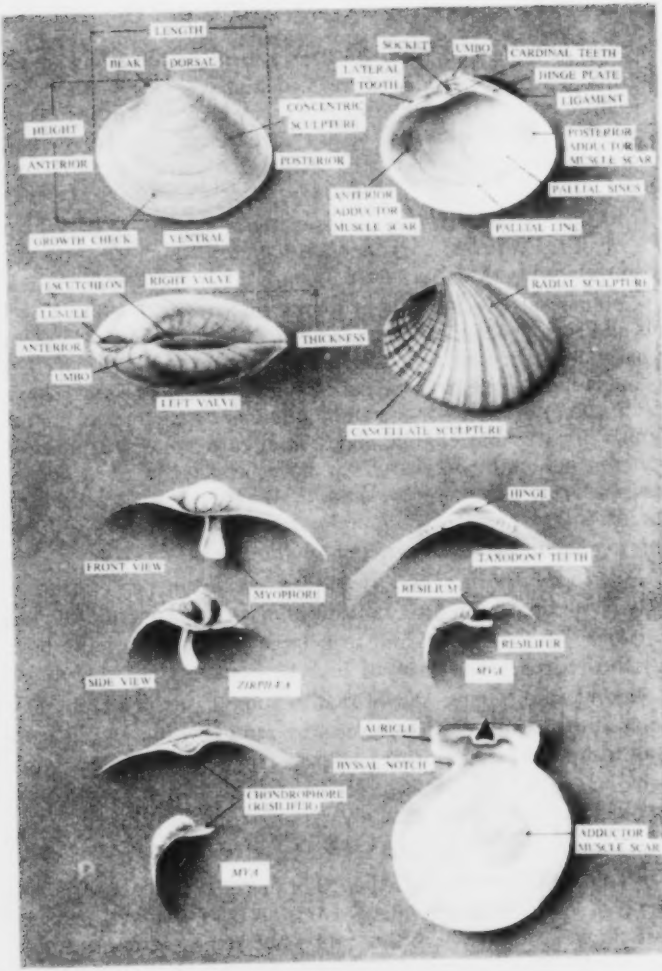


Fig. 3. Parts and characteristics of bivalve shells.

PARASITES AND COMMENSALS

Little is known of the parasites of British Columbia lamellibranchs, and only a few have been identified. One of these is a nemertean worm (*Malacobdella grossa*), which lives in the mantle cavity of *Macoma secta* and in the razor clam (*Siliqua patula*). Another parasite occurs in the pericardial cavity of the latter species.

Mussels (*Mytilus edulis*) and sometimes oysters are parasitized by a small red copepod (*Mytilicola orientalis*) which was presumably introduced with oysters from Japan.

Commensals are animals or plants that live with other organisms and reap benefit from the activities of the host but cause them no harm. The horse clam (*Schizothaerus capax*) almost invariably has one adult female or a pair of pea crabs (*Pinnixa faba* (Dana) or *P. littoralis* Holmes) living within the mantle cavity. A number of other bivalves may contain males, immature females, or juveniles of these same crab species. They have been recorded in *Saxidomus giganteus, Clinocardium nuttalli, Mya arenaria, Macoma nasuta, M. irus, M. secta, Entodesma saxicola, Gari californica, Venerupis japonica, Solen sicarius,* and *Siliqua patula.*

Fabia subquadrata Dana is another species of pea crab found singly (not in pairs) in *Saxidomus giganteus, Mytilus californianus, M. edulis, Mya arenaria,* and in a large percentage of the horse mussels dredged in the Strait of Juan de Fuca.

Recent studies have shown that in some cases pea crabs have damaged the ctenidia of their hosts by removing bits of gill tissue along with food trapped in the mucus. In view of this, pea crabs might better be classed as parasites rather than harmless commensals.

PEARLS

Many British Columbia lamellibranchs produce pearls, but none is of value. The sea mussel (*Mytilus californianus*) produces pearls in considerable numbers, and while some are found free or loose, many are blister pearls, being merely protuberances of nacre on the inner lining of the shell. Indeed, pearls are only layers of

nacre secreted around a nucleus, which may be simply a sand grain or, in some cases, a cyst of a parasite.

Pearl-culture has been brought to a high degree of perfection in Japan, where artificial nuclei are encased in a layer of mantle epithelium and inserted within a slit in the body wall of *Pinctada*, the so-called pearl oyster. The oysters are then returned to the sea for several years before being reharvested for the removal of pearls.

LIST OF FAMILIES AND SPECIES OF BIVALVE MOLLUSCS INCLUDED IN THIS BOOKLET

Glycymeridæ.
Glycymeris subobsoleta (Carpenter).

Anomiidæ.
Pododesmus macroschisma (Deshayes).

Mytilidæ.
Mytilus edulis Linnæus.
Mytilus californianus Conrad.
Modiolus rectus (Conrad).

Pectinidæ.
Pecten caurinus Gould.
Hinnites multirugosus (Gale).

Ostreidæ.
Crassostrea gigas (Thunberg).
Crassostrea virginica (Gmelin).
Ostrea lurida Carpenter.

Tellinidæ.
Tellina bodegensis Hinds.
Tellina salmonea Carpenter.
Tellina buttoni Dall.
Tellina carpenteri Dall.
Macoma insconspicua (Broderip & Sowerby).
Macoma secta (Conrad).
Macoma nasuta (Conrad).
Macoma irus (Hanley).

Semelidæ.
Semele rubropicta Dall.

Solenidæ.
Silqua patula (Dixon).
Solen sicarius Gould.

Mactridæ.
Schizothaerus nuttalli (Conrad).
Schizothaerus capax (Gould).
Spisula falcata (Gould).

Cardiidæ.
Clinocardium nuttalli (Conrad).

Gariidæ.
Gari californica (Conrad).

Veneridæ.
Protothaca staminea (Conrad).
Venerupis tenerrima (Carpenter).
Venerupis japonica (Deshayes).
Saxidomus giganteus (Deshayes).
Transennella tantilla (Gould).
Psephidia lordi (Baird).

Ungulinidæ.
Diplodonta orbellus Gould.

Lyonsiidæ.
Lyonsia pugettensis Dall.
Entodesma saxicola Baird.
Mytilimeria nuttalli Conrad.

Erycinidæ.
Kellia laperousi Deshayes.
Pseudopythina rugifera (Carpenter).
Turtonia minuta Fabricius.
Mysella tumida (Carpenter).

Myidæ.
Cryptomya californica (Conrad).
Mya arenaria Linnæus.
Mya truncata Linnæus.
Platydon cancellatus (Conrad).

Hiatellidæ.
Panope generosa Gould.
Hiatella gallicana (Lamarck).
Hiatella pholadis (Linnæus).

Pholadidæ.
Penitella penita Conrad.
Penitella gabbi Tryon.
Zirphæa pilsbryi Lowe.

Teredinidæ.
Bankia setacea Tryon.

KEY

Keys are schemes designed to permit identification of species, genera, etc., by means of outstanding characteristics which are presented as alternative choices. The bracket-type key given here is for family determination; it employs mainly shell characteristics.

In using the key, start with statement 1. As an example, let us assume the specimen to be identified is without a myophore. Proceed to statement 2. If the valves are equal, proceed to statement 7 and then to statement 8. If all the statements here apply, the specimen belongs to the family Mytilidæ and may be identified as to species by referring to the detailed description and illustrations given in the section devoted to this family.

KEY TO THE FAMILIES OF INTERTIDAL BRITISH COLUMBIA LAMELLIBRANCHIA

PAGE

1 (34) Myophore absent.

2 (7) Valves not equal.

3 (4) Calcareous byssus through hole in lower (right) valve.
Family ANOMIIDÆ 20

4 (3) No calcareous byssus through hole in lower valve.

5 (6) Ears on each side of umbones; ligament internal; radial ribs prominent.
Family PECTINIDÆ 27

6 (5) No ears; shell usually fluted; usually attached by lower (left) valve.
Family OSTREIDÆ 31

7 (2) Valves equal.

8 (9) Adductor muscle scars unequal; umbones at or near anterior end; byssal attachment.
Family MYTILIDÆ 22

9 (8) Adductor muscle scars equal.

10 (13) Resilifer present.

11 (12) Resilifer in left valve only.
Family MYIDÆ 77

12 (11) Resilifer in both valves; triangular.
Family MACTRIDÆ 50

13 (10) Resilifer absent.

14 (21) Pallial line entire (without sinus); shells usually small.

15 (18) Ligament internal.

16 (17) Teeth few; heterodont.
Family ERYCINIDÆ 72

17 (16) Teeth many; taxodont.
Family GLYCYMERIDÆ 19

18 (15) Ligament external.

PAGE

19 (20) Radiating ribs; shell heart-shaped.
Family CARDIIDÆ 54

20 (19) No radiating ribs; shell orbicular.
Family UNGULINIDÆ 68

21 (14) Pallial line indented to form a sinus.

22 (23) Ligament internal.
Family LYONSIIDÆ 69

23 (22) Ligament external.

24 (25) Shell with shiny brown periostracum.
Family SOLENIDÆ 47

25 (24) Shell without shiny brown periostracum.

26 (29) Shell with radiating bands of red.

27 (28) Shell elongate.
Family GARIIDÆ 56

28 (27) Shell rounded.
Family SEMELIDÆ 45

29 (26) Shell without radiating bands of red.

30 (31) Hinge on shorter end of shell; siphons separate.
Family TELLINIDÆ 37

31 (30) Hinge on longer end of shell; siphons fused.

32 (33) Shell with ragged periostracum; gaping; hinge toothless or with two weak cardinals.
Family HIATELLIDÆ 84

33 (32) Shell smooth or sculptured; hinge with three diverging cardinal teeth in each valve.
Family VENERIDÆ 58

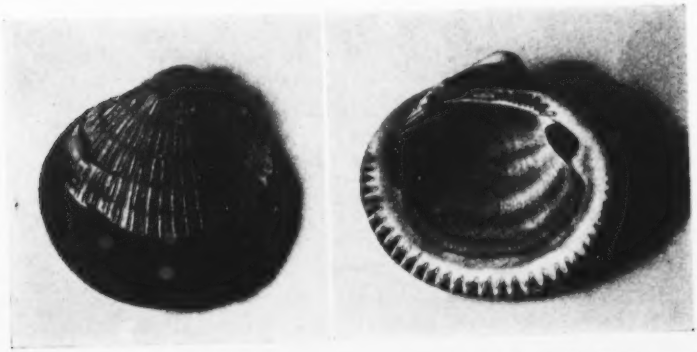
34 (1) Myophore present.

35 (36) Shell small, globular, not covering whole animal; wood-borers.
Family TEREDINIDÆ 93

36 (35) Shell large, elongate, divided into two sections by different striations; clay or stone borers.
Family PHOLADIDÆ 88

FAMILY GLYCYMERIDÆ

Shell strong, size variable, round. Nearly equilateral. Hinge with semi-circular rows of transverse teeth. Adductor muscles subequal. Pallial line simple. Shell margin crenulate inside.



***Glycymeris subobsoleta* (Carpenter)** **Ark Shell, Bittersweet**

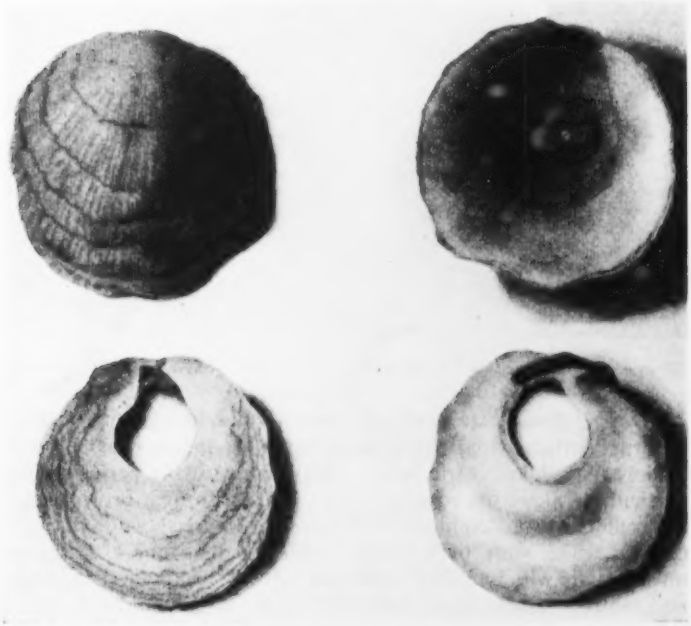
Description.—Size small to 1 inch. Shape triangular, rounded. External surface with definite radial sculpture fading near umbone. Widely spaced concentric lines. Heavy brown flaky periostracum, particularly along the edges. Colour white with light-brown areas. Internally, margins crenulate with radial sculpture showing through. Colour white with pink-brown outside pallial line. Adductor muscle scars with bands of white and brown. Umbones prominent and central. Hinge ligament a flat triangle, largely internal, with a small portion visible externally.

Distribution.—Aleutian Islands to Lower California. British Columbia: Departure Bay (Vancouver Island), Egmont Reef, Hope Island.

Habitat.—Sand and light gravel. Intertidal to 25 fathoms.

FAMILY ANOMIIDÆ

Shell irregular, inequivalve. Hinge with no teeth. Attached to substratum with oval calcified byssus through large perforation in lower valve. Adductor muscle single, pallial line continuous.



Pododesmus macroschisma **(Deshayes)** — **Rock Oyster, Jingle, Money Shell**

Description.—Shell large, to 5 inches in diameter. Shape mainly circular but may be irregular, according to the form of the object to which it is attached. External surface with light radiating striæ and a few concentric lines; often obscured by plant or animal growth. Internally the upper (left) valve generally highly polished

and iridescent green in colour. Lower (right) valve is usually thinner and smaller than upper and perforated by a pear-shaped byssal aperture. Umbone not prominent and placed near edge. Hinge ligament internal.

Distribution.—South Bering Sea to Mexico and west from the Pribilof Islands to Japan. British Columbia: Generally distributed; North Beach (Masset), Ladysmith, Pendrell Sound, Victoria.

Habitat.—Attached to solid objects from near low-tide level to 35 fathoms. Occurs in sheltered waters as well as on open coast.

Notes.—The rock oyster is nowhere very abundant. It is used locally as food. The flesh is bright orange in colour. Some species of this group have the start of the byssal notch in the larval shell, while others have only a flattened side where the notch will be formed. The shell adheres very closely to the object to which it is attached by the pear-shaped calcareous byssus. The remnant of the byssal attachment on rocks and shells is often a source of conjecture if it has not been seen before. The breeding season is during the summer.

Family MYTILIDÆ

Shells equivalve, inequilaterial. Anterior muscle scars small, posterior impression large. Ligament long, narrow, in a groove. No hinge teeth. Well-developed byssus.

Mytilus edulis **Linnæus** **Edible Mussel, Blue Mussel, Bay Mussel**

Description.—Shell small, to 2 inches in length. Shape elongate, anterior end pointed, posterior rounded. Externally quite smooth with fine concentric sculpture. Black, blue, or brown periostracum, but usually blue where worn off. Internally, dull blue in colour. Umbones terminal. Hinge ligament both internal and external.

Distribution.—Arctic Ocean to California. In Atlantic also. British Columbia: Generally distributed; Ladysmith, Victoria, Comox (Vancouver Island), Queen Charlotte Islands.

Habitat.—Occurs in dense patches in the intertidal zone attached to rock or gravel by strong byssal threads; also on piling and floats.

Notes.—This is the same species that is marketed extensively in Europe for food. Culturing the species here to grow it to a larger size as is done in Europe would probably make it acceptable to the market here also. Mussels are quite edible; it may be the many myths indicating them to be poisonous in some situations that prevent this species being used more. Actually there is no danger if the mussels are used fresh from waters uncontaminated by sewage. In Pacific-oyster-growing areas this species may be parasitized by the copepod *Mytilicola orientalis*, which lives in the intestinal tract of the mussel. However, this parasite is not dangerous to humans. The breeding season of *Mytilus* is quite long; in Ladysmith Harbour the larvæ may be found from May to December, but the main breeding period is during the warm months. Dense masses of mussels form an excellent home for many species of small marine animals.

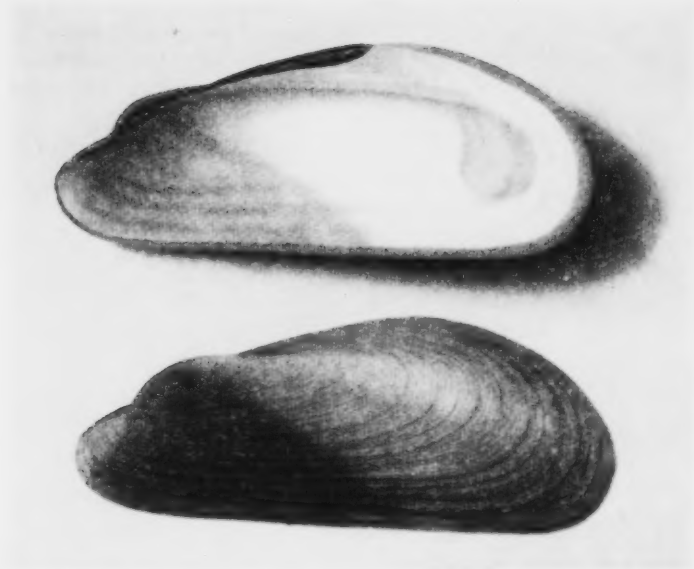
***Mytilus californianus* Conrad** **California Mussel, Sea Mussel**

Description.—Shell large, to 10 inches in length. Same general shape as *Mytilis edulis*. About twelve quite prominent ribs emanate from just above the umbone and extend to the end of the shell. The surface may be so eroded, or encrusted with other organisms, that these lines are not visible. Young shells covered with a thick, shiny black periostracum which usually cracks and peels off if the shell is allowed to dry. Internally the shell slightly iridescent and generally blue-grey in colour. Umbones terminal. Hinge ligament partly internal and partly external.

Distribution.—Aleutian Islands to Mexico. British Columbia: General along the outer coast; Effingham Island, Victoria, Ucluelet (Vancouver Island), Tow Hill (Queen Charlotte Islands).

Habitat.—Found only on the open coast-line in the intertidal zone attached by strong byssal threads to rocky surf-swept shores, or in sheltered arms adjoining the open sea.

Notes.—This species with its bright orange flesh is edible and it is eaten locally. It is, however, one of the species which can cause paralytic shellfish poisoning. Most specimens contain considerable numbers of tiny pearls of variable shapes and of no value.



***Modiolus rectus* (Conrad)** **Giant Horse Mussel, Fan Mussel**

Description.—Size large, to 8 inches. Wedge-shaped, oblong with concave ventral margin, rounded at both ends. External surface with light concentric sculpture covered with a shiny brown periostracum. May be slightly hairy at the broad end. Internally, a shiny blue-white colour. Hinge ligament is largely internal. Umbone not terminal as in *Mytilus* but near the anterior (narrow) end.

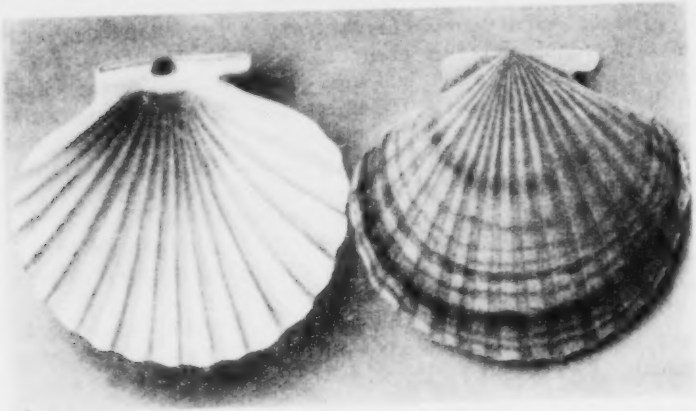
Distribution.—Vancouver Island to California. British Columbia: Disappointment Inlet; Jervis Inlet; Lasqueti Island; Ganges Harbour; Ladysmith, Comox, Esquimalt (Vancouver Island).

Habitat.—Solitary, growing vertically in the sand, gravel, or mud on tidal flats in quiet bays with only the posterior tip of the shell protruding. Attached by a byssus. Intertidal to 25 fathoms.

Notes.—Also known as *Volsella flabellatus* Gould.

Family PECTINIDÆ

Shell free, auricled. Ligament completely or partially internal, placed in a groove below umbones. Single adductor muscle.



***Pecten caurinus* Gould** **Weathervane Scallop, Giant Pacific Scallop**

Description.—Size large, to 9 inches. Shell thin, nearly circular in outline. Right valve (on which the scallop lies) white or brown with twenty broad flat-topped ribs; left valve smaller, not so cupped; reddish or white with about seventeen low, rounded ribs. Hinge line straight without teeth. Internal shell smooth, glossy, white or light olive in colour. Ligament internal, single adductor muscle scar. Ears nearly equal. Umbones central, not prominent.

Distribution.—Alaska to California. British Columbia: Masset, Hecate Strait, Stuart Channel, Satellite Channel, Plumper Sound.

Habitat.—At depths usually greater than 10 fathoms. On soft sand and mud.

Notes.—There are several smaller species of scallops in British Columbia waters, but these are also mainly deep-water forms,

usually obtained only by dredging. So far no commercial fishery for scallops exists. Only the single adductor muscle (sometimes called the " eye ") is used for food.

Along the broad tentacle-fringed mantle edge are numerous brightly shining eyes, each having a retina and focusing lens.

The scallop has extraordinary swimming ability, and the normal mode of propulsion occurs when it literally takes " bites " of water, closes the mantle curtain, and forces the water out of the shells in the region of the ears. The direction of the movement is with the hinge behind. By taking successive " bites " of water the scallop is able to swim for some distance. Escape movements occur in the opposite direction with the hinge in front. This is done by forcing water through an opening in the mantle. The actual direction of motion may be altered by the position of the opening in the mantle curtain. An extensive fishery for scallops occurs on the North Atlantic Coast.

While the weathervane scallop is not an intertidal species, it is included because it is a well-known type of shell and an interesting animal.

***Hinnites multirugosus* (Gale)** **Purple-hinged Rock Scallop**

Description.—Size large, to 10 inches in diameter. Shape typically circular but may be quite irregular. External surface of upper (left) valve sculptured with strong, unequal radiating ribs studded with short fluted spines. This valve, normally brown or green in colour, may be pitted with the holes of boring animals or encrusted by plant and animal growth. Internally the shell smooth but not glossy, and white in colour except for the deep-purple hinge area. Umbones central.

Distribution.—Aleutian Islands to California. British Columbia: Generally distributed; Jervis Inlet; Effingham Island; Cape Naden; Hardy Bay, Ladysmith, Victoria (Vancouver Island).

Habitat.—Attached to rocks or hidden in rocky crevices from just at low tide to 25 fathoms. Until this species attains a diameter of 1 to 2 inches, it is free-swimming like other scallops, but thereafter becomes attached with the right valve adhering to a rocky

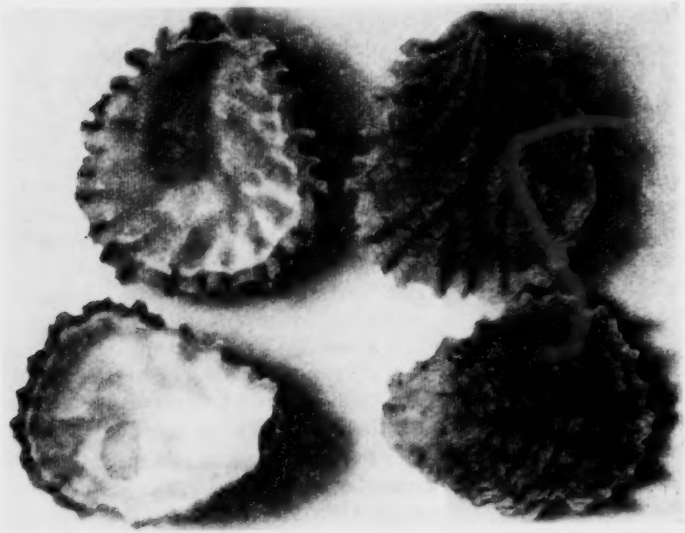
substrate, usually in crevices, to whose surface the shell conforms as it grows. The outline of the shell as it existed during the free-swimming period may be seen. Prior to attachment the hinge is marginal, but in cases where the animal becomes attached in a crevice, Professor C. M. Yonge has found that the ligament and functional hinge line migrate ventrally to allow the valves to open as the shell grows.

Notes.—Sexes are separate; the male gonad is white, while that of the female is bright red in colour. The mantle edges, which form the so-called "pallial curtain," are orange in colour and fringed with tentacles. On the middle lobe of the mantle edge are located eyes, which number about sixty. This species is not very abundant in the intertidal area. It is edible and only the large adductor muscle is used as food.

Formerly known as *Hinnites giganteus* Gray.

FAMILY OSTREIDÆ

Shell irregular, fluted, usually attached by lower (left) valve. Ligament internal or semi-internal. Single muscular impression sub-central. No foot.



***Crassostrea gigas* (Thunberg)** **Pacific Oyster, Japanese Oyster**

Description.—Size up to 12 inches in length. Shape very irregular, depending upon environment and degree of crowding. In colour grey or white; new growth often black or purple. External surface quite smooth or very highly fluted. Internally shells white with a smooth polished surface. Lower or left valve usually cupped and the upper or right valve generally quite flat and smaller than the other valve. Umbones terminal and hinge ligament not normally visible externally.

Distribution.—Northern British Columbia to California; Japan. British Columbia: Georgia Strait; Barkley Sound, Nootka Sound (Vancouver Island). Planted elsewhere.

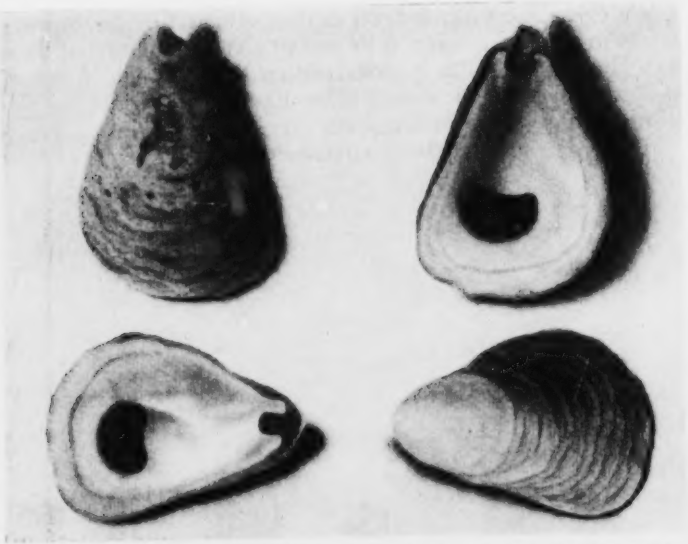
Habitat.—Occurs on almost every type of beach between tide marks.

Notes.—On muddy grounds this species tends to grow long and thin and with soft, relatively smooth shells, while on firm ground the tendency is toward a more circular shape with hard, highly fluted shells. Initially there is always an attachment to some solid object. If the object is small or friable, the grown oysters may be freed, but if the object is large and solid, most of the lower or left valve is cemented to it.

This species was originally imported from Japan as young oysters which are called " seed " or " spat," and planted on oyster-beds here. Seed is still imported annually to restock the beds, though not absolutely necessary. Seed is caught in Japan on the empty adult shells (" cultch "), which are punched and strung on wires suspended from rack or floats. After a period of condition-ing, seed is packed in wooden boxes and shipped as deck cargo to this coast in early spring while the weather is cool. By keeping the young oysters damp, it is possible to keep them out of water for periods of two to three weeks with relatively little mortality. The British Columbia oyster industry is based entirely on this species, and Georgia Strait is the centre of its culture.

Pacific oysters may live for over twenty years and reach a length of 12 inches or more. The market is usually supplied with oysters about 4 to 5 inches in length when they are about 3 years old. However, rates of growth vary greatly, depending upon the envi-ronment. Oysters are preyed upon by gastropod snails (oyster drills) which, by means of the radula, drill a tiny hole in the shell of the oyster through which they feed on the meat. Sea stars (starfish) are also predators. Breeding in British Columbia occurs in Ladysmith and Pendrell Sound and normally takes place in July and August.

Formerly known as *Ostrea gigas* Thunberg.



***Crassostrea virginica* (Gmelin)** **Eastern Oyster, Atlantic Oyster**

Description.—Size large, to 6 inches. Pear-shaped. Externally the shell fairly smooth with concentric sculpture. Generally light brown in colour. Internally smooth and white. Umbones terminal, and hinge not visible externally. Adductor muscle scars black or dark blue, and this feature distinguishes it clearly from Pacific or native oysters.

Distribution.—Atlantic Coast of North America. British Columbia: Boundary Bay.

Habitat.—In British Columbia, only on Boundary Bay tidal flats and mouth of the Nicomekl River.

Notes.—This species was introduced from the Atlantic Coast, where it is known under such names as Malpeque (Canada) or Blue Point (U.S.A.) as well as numerous others. It has been planted at a number of points on the Pacific Coast but has not adapted itself well to West Coast conditions. Breeding on the

Pacific Coast has been confined to river estuaries. Plantings are known to have been made at Esquimalt and Ladysmith, but these were unsuccessful. The reproductive method is similar to that of the Pacific oyster. The mantle of the Eastern is not as highly pigmented as that of the Pacific oyster.

Formerly known as *Ostrea virginica* Gmelin.

***Ostrea lurida* Carpenter** **Native Oyster, Olympia Oyster**

Description.—Size small, to 2 inches in diameter. Shape generally circular. Externally the shell grey in colour and seldom fluted; internally quite nacreous and often an iridescent olive-green in colour. Dorsal and ventral margins of shell near hinge, crenulate. Ligament not visible externally and umbones are terminal.

Distribution.—Alaska to Lower California. British Columbia: Generally distributed; Ladysmith, Esquimalt, Barkley Sound (Vancouver Island); Boundary Bay; Blunden Harbour.

Habitat.—On mud or gravel flats near estuaries or in tide pools near low-tide level. Often under rocks.

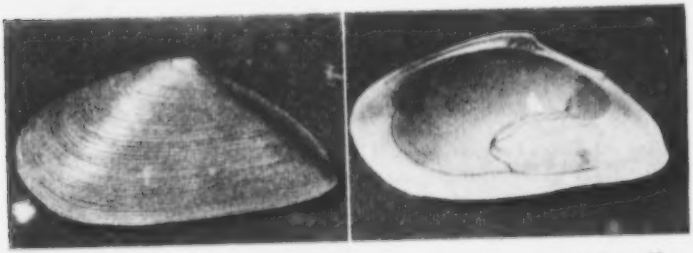
Notes.—The native oyster occurs in small numbers in various parts of Georgia Strait and in estuaries and tidal lagoons on the

north-west coast of British Columbia. It is very susceptible to temperature changes, consequently in Puget Sound it is cultured in water-covered dykes. Until 1930 the British Columbia oyster industry was based mainly on the native oyster, but it was essentially a fishery rather than a culture, and now none is produced.

Individual oysters are either male or female, and the sex may change during the spawning season. The fertilized eggs hatch within the mantle cavity of the female, and the young oysters are retained until the shell is well developed.

FAMILY TELLINIDÆ

Shell equivalve, compressed. Ligament external on shortest side of shell. Pallial impression deeply sinuated, adductor scars far apart. Siphons long, slender, separate.



***Tellina bodegensis* Hinds** **Bodega Clam**

Description.—Size medium, to 2 inches. White. Shape elongate, with umbones posterior to centre. Anterior end rounded. A ridge or shallow groove extends from umbone to basal margin. External surface polished and smooth with definite fine, even incremental lines. Posterior ends bend slightly to right. Internally smooth and white. Hinge ligament external and prominent.

Distribution.—Queen Charlotte Islands to Gulf of California. British Columbia: Nawhitti Bar; Quatsino Sound, Long Beach (Vancouver Island).

Habitat.—Not common and generally found only on beaches exposed to open ocean.

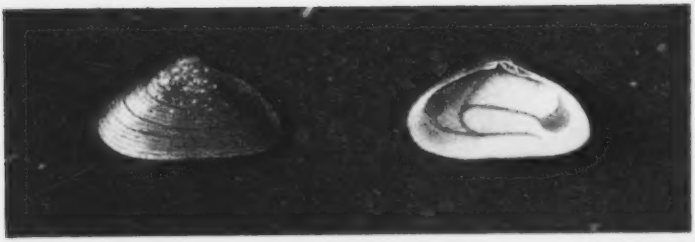
***Tellina salmonea* Carpenter** **Salmon Tellen**

Description.—Shell small, to one-half inch. Solid and smooth with prominent growth checks on highly polished yellow or white surface. Interior often tinged with pink. Posterior end short and bluff. Hinge ligament short, protruding just below the umbones.

Distribution.—Aleutian Islands to California. British Columbia: Comox Spit, Quatsino Sound, Sidney (Vancouver Island); Masset (Queen Charlotte Islands).

Habitat.—A sand dweller, both intertidal and in deep water.

Notes.—This tiny clam may often be found making irregularly shaped tracks on the surface of the sand as it moves along just below the surface riding on its hinge. It forms a part of the food of commercial crabs.

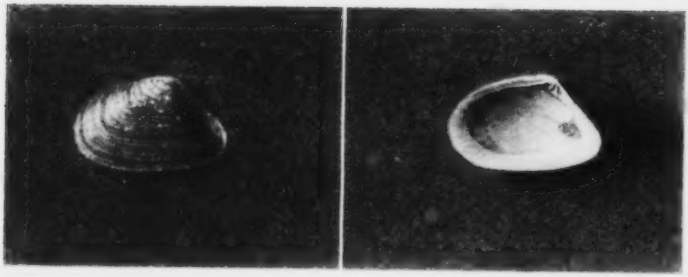


***Tellina buttoni* Dall** **Button Tellen**

Description.—Shell small, to three-quarters of an inch; thin; shape oval; external surface with light concentric sculpture, fairly shiny, white-yellow in colour. Eroded in umbonal region; slightly flattened area extending from umbone to anterior ventral area, indicated by irregularity of shell outline. Interior shiny with a thickened ray extending from umbone between anterior adductor muscle and pallial sinus. Muscle scars difficult to distinguish. Hinge external, prominent.

Distribution.—Alaska to Gulf of California. British Columbia: Qualicum Beach (Vancouver Island); Gillies Bay.

Habitat.—In sand and mud.

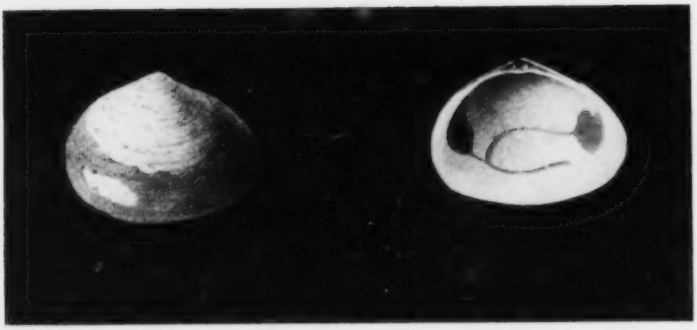


***Tellina carpenteri* Dall** **Carpenter Tellen**

Description.—Shell small and fragile, to one-half inch. Shape elongate. External surface shiny with concentric sculpture, porcellaneous, eroded in dorsal area. White to dark pink in colour. Ridge or break in shell curve, from umbo to posterior ventral edge. Umbones not prominent, placed well to anterior. Short prominent external hinge.

Distribution.—Alaska to Gulf of California. British Columbia: Jervis Inlet; Boundary Bay; Tsawwassen Bay; Qualicum, Crofton (Vancouver Island).

Habitat.—In sand and mud, from the shallows into deep water.



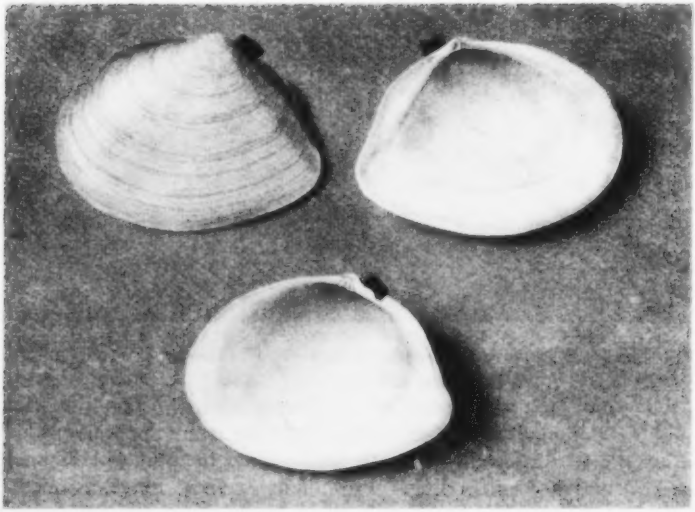
***Macoma inconspicua* (Broderip and Sowerby) Inconspicuous Macoma**

Description.—Size small to medium, to 1 inch. Shell oval in outline, flattened with thin, yellow periostracum and an eroded appearance. Internally smooth and yellow or pink. Umbones central and not protruding. Prominent external hinge ligament.

Distribution.—Arctic Ocean to San Diego. British Columbia: Generally distributed.

Habitat.—Generally found in sheltered waters in sandy-mud bottom. Intertidal to deep water.

Notes.—A common species. Formerly known as *Macoma balthica* Linnæus, a name now reserved for an Atlantic Coast species.



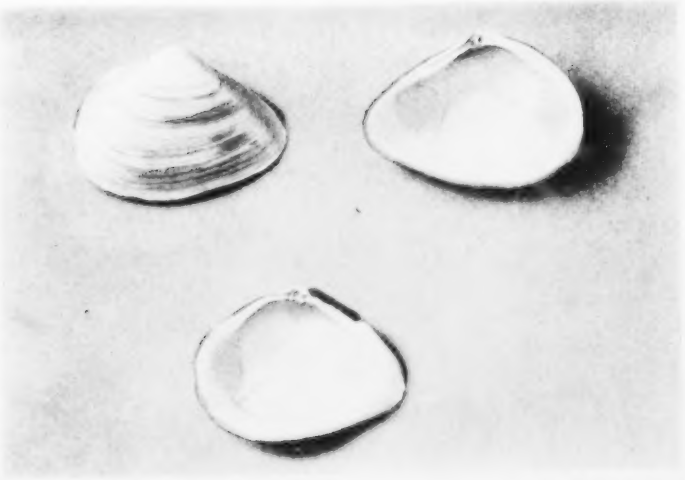
***Macoma secta* (Conrad)** **Sand Clam, Cleft Clam**

Description.—Medium size, to 4½ inches. Shell solid, posterior with a sharp angle and a diagonal ridge from umbo to posterior ventral margin. Posterior slope steep. Ligament thick, prominent and short, inserted on a rib-like callus. Colour white, internally smooth, glossy white.

Distribution.—Vancouver Island to Gulf of California. British Columbia: Victoria, Comox, Clayoquot (Vancouver Island); Saltspring Island; Hernando Island. Common.

Habitat.—In sand in sheltered waters. Intertidal to 25 fathoms.

Notes.—Bay and open ocean populations are usually quite distinct. Individuals may burrow to a depth of 18 inches.



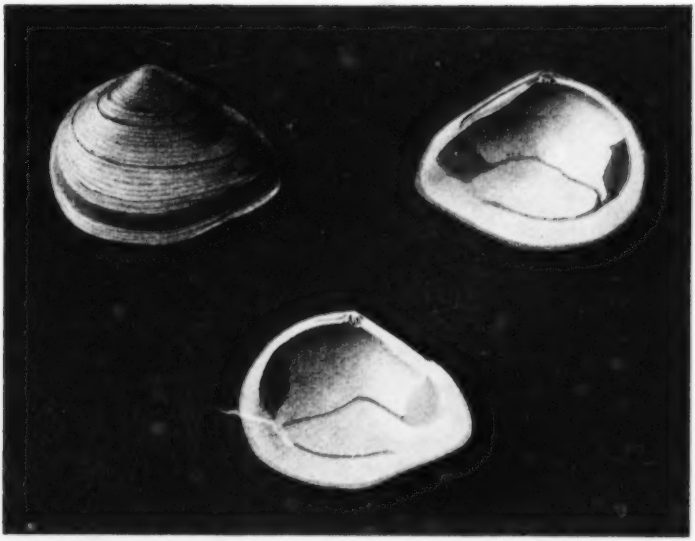
***Macoma nasuta* (Conrad)** **Bent-nose Clam**

Description.—Size medium to small, to 2 inches. Oval, smooth; anterior end rounded, posterior rather pointed. Umbones central with a fold close to posterior dorsal edge. Posterior end of valves markedly flexed to the right. Grey-brown periostracum, particularly in ventral and posterior regions. Relatively long external hinge ligament.

Distribution.—Alaska to Lower California. British Columbia: Ladysmith, Crofton, Qualicum, Mud Bay, Clayoquot (Vancouver Island); Lasqueti Island. Common.

Habitat.—In mud and sand in protected waters. Intertidal down to 25 fathoms.

Notes.—This species is able to live under the most unfavourable conditions. It is a detritus feeder with separated siphons. Its normal position is lying on its left side.



***Macoma irus* (Hanley)** **Polluted Macoma**

Description.—Shell small, to 2½ inches. Oval, posterior wedge-shaped. Anterior rather rounded. Smooth or with irregular concentric striations and marginal brown papery periostracum. Ligament large and prominent. External colour cream. Internal white and smooth but not glossy.

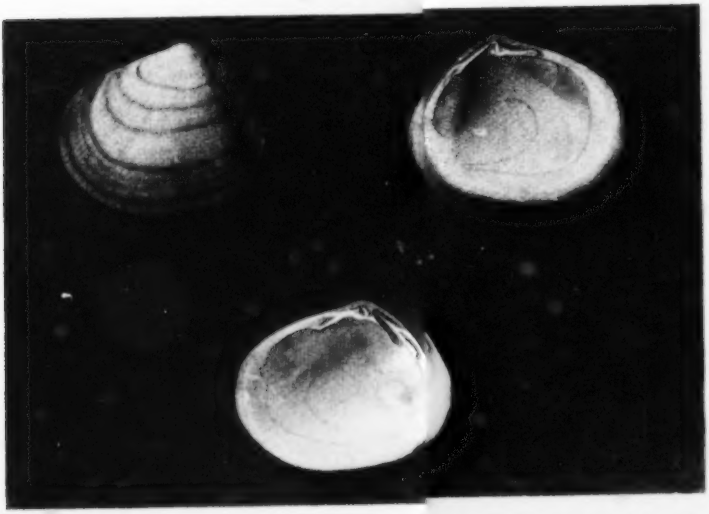
Distribution.—Bering Sea to Monterey, California. British Columbia: Victoria, Comox, Clayoquot Sound (Vancouver Island); Queen Charlotte Islands; Jervis Inlet. Common.

Habitat.—In mud, intertidal to deep water.

Notes.—Known formerly as *Macoma inquinata* Deshayes.

FAMILY SEMELIIDÆ

Shell oval. Hinge with two primary teeth in each valve. A long narrow pit between teeth for internal cartilage. Thin external ligament. Muscle impressions round. Pallial line with deep sinus.



***Semele rubropicta* Dall** **Red-painted Semele, Rose Petal Semele**

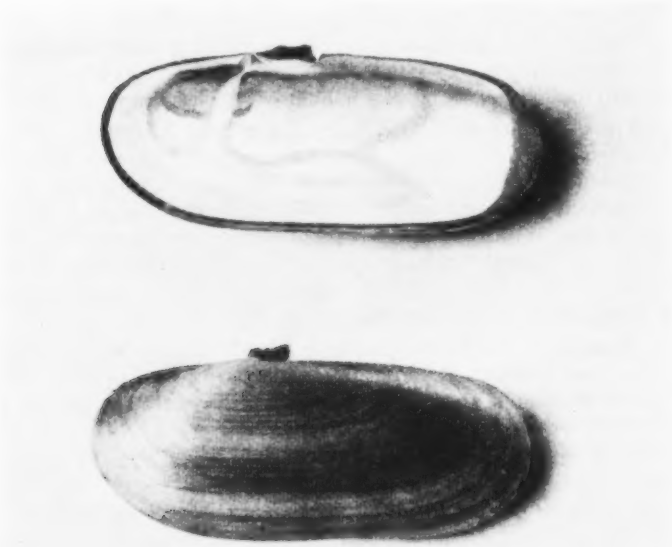
Description.—Shell small to medium, to 2 inches. Rounded in shape and solid. External surface sculptured with fine radiating striæ. Definite concentric growth checks and minor incremental lines. Margins with yellow-brown periostracum. Internally, shells glossy white with very fine radiating lines. Adductor muscle scars high up on shells, close to hinge area. Pallial sinus highly arched. Umbones well to posterior with a small but prominent lunule. Ligament, mainly internal, placed on a fairly long narrow resilifer. Externally, shells tinged with red or pink rays, particularly around edge.

Distribution.—Alaska to Mexico. British Columbia: Comox, Ladysmith, Victoria, Clayoquot Sound (Vancouver Island); Egmont; Burnaby Strait.

Habitat.—In gravel and sand. In California it is found only in water from 25 to 50 fathoms deep, while in British Columbia it may be found in the intertidal zone.

FAMILY SOLENIDÆ

Shell equivalve, narrow, long. Hinge strengthened by internal rib. Teeth usually two and three. Ligament external, umbones not prominent.



***Siliqua patula* (Dixon)** **Razor Clam**

Description.—Shell large, to 6 inches; thin and brittle. Shape rather long and narrow. In very young specimens periostracum brown but in small to medium-sized animals more olive-green in colour, changing again to brown with age. In large specimens the periostracum usually eroded in umbonal region. Internally, shell glossy white, sometimes with purple areas showing through and with a prominent rib extending from umbone to shell edge. Hinge

ligament mainly external. Definite, but not prominent umbones placed about two-thirds the distance toward anterior end.

Distribution.—Arctic Ocean to California. British Columbia: Long Beach (Vancouver Island); Masset (Queen Charlotte Islands).

Habitat.—In surf-swept sand beaches of the open ocean. Intertidal to several fathoms.

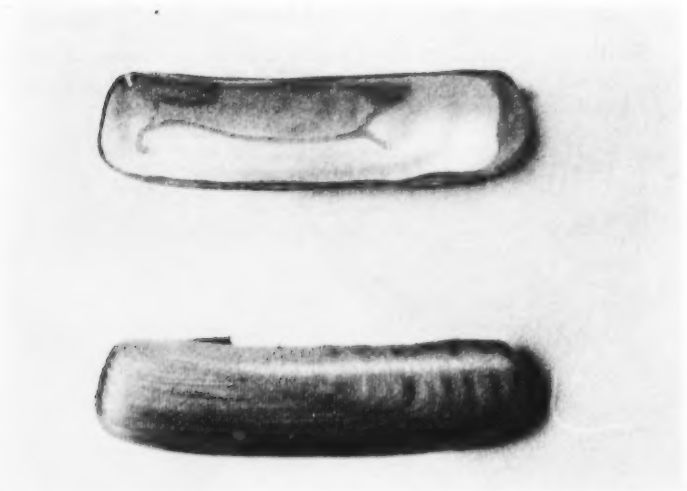
Notes.—This species is taken commercially in widely separated areas from Oregon to Alaska. It is a very active species and can dig into the sand of its normal habitat with considerable speed.

The clams are dug individually ("pin-point" digging as compared to "area" digging used for hard-shell clams) from a "showing" on the sand caused by the movement of the clam as it is disturbed purposely by the heavy stamping of diggers. If the clam is missed on the first effort, it is well to try for another one, for the one missed will have dug itself so deep that it may be obtained only by a considerable excavation. The razor clam lies with its hinge nearly always directed toward the ocean.

Breeding in the Queen Charlotte Islands appears to take place in July and August. Rate of growth has been found to vary, with greatest maximum size and age in the north, where the growth is slower.

A considerable number of razor clams are parasitized by nemertean worms which attach themselves to the ctenidia. Another worm parasite is often found in the chamber around the heart.

The only commercial razor clam operation in British Columbia at present is on the beach between Rose Spit and Masset on the north-west shore of Graham Island (Queen Charlotte Islands).



***Solen sicarius* Gould** **Jackknife Clam**

Description.—Size medium, to 6 inches. Shape oblong with height about one-quarter the length. Posterior end incurved, while anterior is rounded. External surface covered by a smooth, glossy olive-brown periostracum, interspersed with reddish-brown concentric bands. Internal surface smooth with a dull blue-white colour. Hinge ligament external. Umbones terminal.

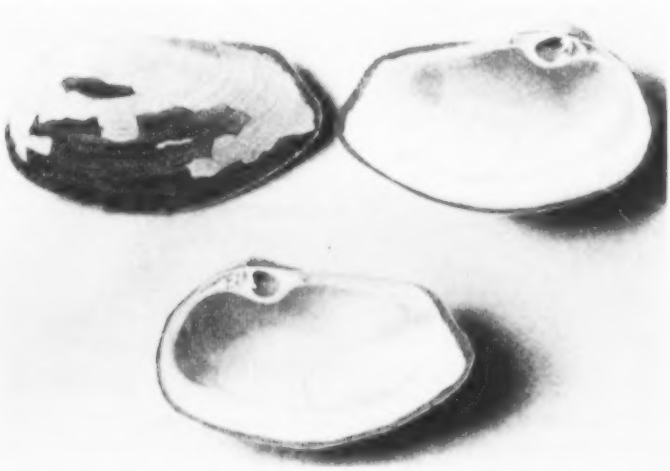
Distribution.—Queen Charlotte Islands to Lower California. British Columbia: Naden Harbour (Queen Charlotte Islands); Jervis and Sechelt Inlets; Comox, Ladysmith, Departure Bay, Clayoquot Sound, Witty's Lagoon, Boat Harbour (Vancouver Island); Protection Island.

Habitat.—In sand-mud flats to deeper water.

Notes.—Little is known of this clam. It is closely allied to razor clams and undoubtedly has the same ability to dig rapidly. A related species, *Solen rosaceus,* which occurs only in California, has an annulated siphon, and under certain conditions parts of it may be broken off and regenerated.

Family MACTRIDÆ

Shell equivalve and more or less triangular in shape. Lateral teeth distinct. Ligament sub-external with cartilage. Muscle scars deep and distinct. Periostracum usually present.

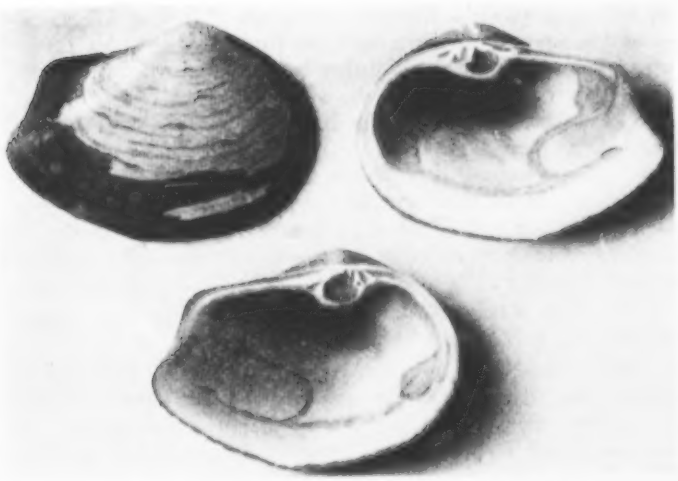


***Schizothærus nuttalli* (Conrad)** **Horse Clam, Gaper**

Description.—Shell large, to 8 inches in length and 5 to 6 inches high. Valves unequal, with upswept extended posterior region which gapes widely. Shell white or yellow with fairly smooth concentric sculpture and with varying amounts of brown to black periostracum which peels readily. Interior sometimes chalky, sometimes nacreous. Ligament small but internal resilium large and strong with a heavy black-brown resilifer. Umbones displaced well to the anterior.

Distribution.—Said to occur only between 28 and 38 degrees north latitude, but it is common in Georgia Strait and farther north. British Columbia: Rathtrevor Beach, Boat Harbour (Vancouver Island); Clayoquot Sound.

Habitat.—Generally in sandy bottom.



***Schizothærus capax* (Gould)** **Horse Clam, Gaper**

Description.—Formerly considered a subspecies or variety of *Schizothærus nuttalli.* Shell large, to 8 inches; nearly equilateral with the posterior portion being extended only slightly. Shell varies from thin and brittle to quite thick and heavy. Surface usually much rougher than in *Schizothærus nuttalli.* Periostracum dark brown or black in living specimens. Hinge structure is similar to that of *Schizothærus nuttalli.*

Distribution.—Alaska to California. More abundant than *Schizothærus nuttalli* in northern latitudes. British Columbia: Common; Comox, Ladysmith (Vancouver Island); Clayoquot Sound.

Habitat.—Similar to *Schizothærus nuttalli,* but generally in more gravelly habitat.

Notes.—Dr. Emery Swan has studied the problem of differentiating between the two kinds of horse clams, and he believes that the two forms act as full species in the Puget Sound area. He has demonstrated a variability in edibility that may be due to the fact

the two types spawn at different times of the year, with *Schizothærus nuttalli* a summer spawner and the form *Schizothærus capax* a winter spawner. He distinguishes between the two species before digging, using the fact that the siphonal plates of *Schizothærus nuttalli* are heavier and harder than those of *Schizothærus capax* and tend to carry large barnacles. His observations indicate that *Schizothærus nuttalli* digs deeper than does *Schizothærus capax*. In addition, in the latter the dorso-ventral measurement is greater than in the former and the angle on the ventral edge of the shell is much more pronounced in *Schizothærus capax* than in *Schizothærus nuttalli*.

Dr. Myra Keen also considers the two forms to be distinct species.

Samples of *Schizothærus* were dug at Rathtrevor Beach (sand) and at Seal Island (gravel) near Comox and were measured. From these measurements, ratios of height to length and post-umbone length to pre-umbone length were calculated, and when these figures were compared statistically it was found the differences were highly significant. The *capax* form were from Seal Island and the *nuttalli* form from Rathtrevor.

***Spisula falcata* (Gould)** **Hooked Surf Clam**

Description.—Size medium, to 3 inches or more. Solid, with light concentric markings. Anterior end elongated and narrower than posterior. Nearly covered with light-brown or olive iridescent periostracum, with appearance of short, silken hair. Posterior dorsal edge with coarse, dark periostracum. Light radiating lines, particularly evident on slightly concave anterior dorsal surface. Interior smooth and slightly nacreous. Pallial sinus high, short, and rounded. Adductor muscle scars high on shell. Small internal hinge. Resilium similar to but not as large as in *Schizothærus.*

Distribution.—Controversial but known definitely from California to Georgia Strait. British Columbia: Comox, Victoria (Vancouver Island); Seal Island; Lasqueti Island; Gillies Bay; Sechelt Narrows.

Habitat.—Sandy beaches both intertidal and down to 20 fathoms. Shallow burrow. Not abundant.

FAMILY CARDIIDÆ

Shells equivalve with radiating ribs, crenulate margins. Two primary teeth in each valve. Two adductor scars, pallial line entire. Foot long, narrow. Short siphons.

***Clinocardium nuttalli* (Conrad)** **Cockle, Basket Cockle, Heart Cockle**

Description.—Shell heavy, large, to 4½ inches in length. Somewhat triangular in shape, heart-shaped in cross-section. Young light brown and mottled, darker with age. External surface with 37–38 prominent radiating ribs covered with a thin periostracum. Muscle scar evident. No pallial sinus. External ligament. Chalky inside pallial line; nacreous outside it.

Distribution.—Bering Sea to San Diego. British Columbia: Ladysmith, Port Hardy, Clayoquot Sound, Victoria (Vancouver Island); Protection Island; Burnaby Strait; Boundary Bay.

Habitat.—In sand-mud beaches, both deep water and intertidal. Often found on eel-grass flats. Frequently found on the surface of

tidal flats and with shallow burrows because of very short siphons. Moves by vigorous action of a long, muscular foot.

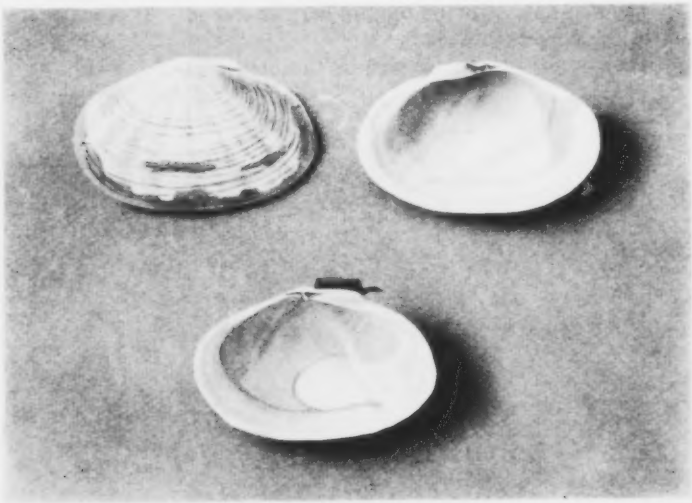
Notes.—The cockle rarely lives beyond 7 years of age. It is hermaphroditic. Breeding takes place in summer beginning at the age of 2 years.

The cockle is common but not very abundant. It occasionally enters the commercial catch.

The species is better known as *Cardium corbis* Martyn.

Family GARIIDÆ

Shell nearly equilateral, long oval, compressed, pronounced external ligament. Two cardinal teeth in each valve. Pallial sinus deep and for most part joined with pallial line.



***Gari californica* (Conrad)** **Sunset Shell**

Description.—Size medium, to 3 inches; shell thin. Longer than high with rounded ends. External shell edges normally covered with a thin brown periostracum. Shell white, tinged with pink, radiating lines. Fine irregular concentric incremental lines. Internal surface smooth and white. Muscle scars glazed in comparison to remainder, which is more chalky. Pallial sinus almost square. Prominent umbones small, central. Hinge external, and under it the dorsal edge of the shell is raised into a wedge-like extension.

Distribution.—Japan; Kamchatka; Alaska to California (San Diego). British Columbia: Comox, Northwest Bay, Ladysmith

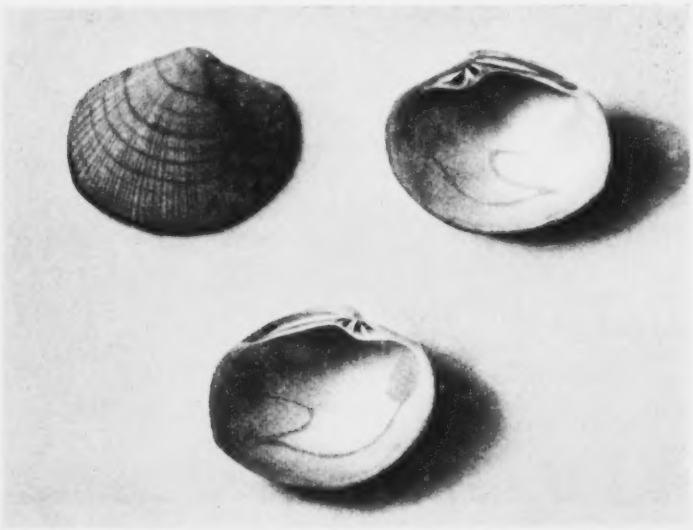
Harbour, Clayoquot Sound, Barkley Sound (Vancouver Island); Denman Island; Jervis Inlet; North Beach (Queen Charlotte Islands).

Habitat.—Intertidal in British Columbia. Rather rare in California and mainly in deep water.

Notes.—Formerly known as *Psammobia californica* Conrad.

FAMILY VENERIDÆ

Shell regular and solid. Hinge usually with three diverging cardinal teeth in each valve. Ligament external. Muscle scars smooth, pallial line sinuated.



Protothaca staminea **(Conrad)** — **Native Little-neck Clam, Rock Cockle, Rock Venus**

Description.—Medium size, to 2½ inches. Shape oval to round. External surface sculptured with radiating and concentric striæ. Angular pattern of chocolate brown and white, particularly on young and rapidly growing specimens, but may be white only. Prominent lunule. Internal surface smooth and white with crenulate margin. Hinge ligament external. Umbo prominent and near anterior end of shell.

Distribution.—Aleutian Islands to Lower California. British Columbia: Widespread, particularly on Vancouver Island. Less abundant to the north.

Habitat.—Found on gravel-mud bea aches of protected bays but may be found in a variety of beach type es. Concentrated at about half-tide level but occurs down into sub- -tidal area.

Notes.—The little-neck clam was t the important fresh-market species in British Columbia until the adv vent of Manila clams, but it is still harvested commercially and shipp ped as far as San Francisco.

The favourite way of cooking is to steam.

Breeding occurs during the summer r months, not in February and March as formerly supposed. The larvæ settle when they are little more than one one-hundredth of an inch long. Adults spawn in about the third to the fifth year when they are about an inch in length. Growth is rather slow; about ten years are required to reach maximum size. The tiny snail *Iselica obtusa laxa* may sometimes be found attached to the shell of *Protothaca* by a gelatinous material.

Formerly known as *Paphia staminea* Conrad.

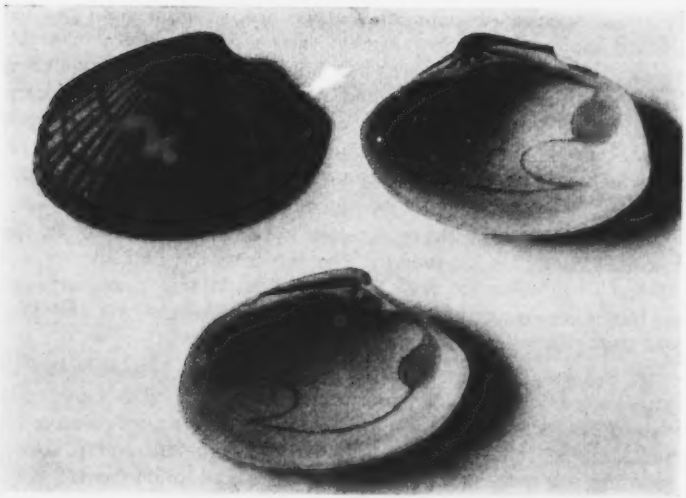
Venerupis tenerrima **Superlative Rock Venus, Finest Carpet Shell,**
(Carpenter) **Thin-shelled Little-neck**

Description.—Size large, to 4 inches. Quite solid shells, oval in shape. Not as inflated as the other species of little-neck clams. External surface strongly sculptured with prominent concentric ridges and very fine radiating lines. Dull grey-white in colour. Lunule present. Internally smooth and white; edge not crenulate as in *Protothaca staminea*. Hinge ligament external and prominent. Umbones prominent and near anterior end of shell. Gold-coloured periostracum.

Distribution.—Georgia Strait to Lower California. British Columbia: Cadboro Bay, Patricia Bay, Comox Harbour, Clayoquot Sound, Departure Bay (Vancouver Island). Not abundant.

Habitat.—Intertidal sand-gravel beaches to deep water.

Notes.—Formerly known as *Paphia tenerrima* Carpenter.



***Venerupis japonica* (Deshayes)** **Manila Clam, Japanese Little-neck**

Description.—Size medium to 2½ inches. Solid shells. Shape quite oblong, much longer than high. External surface concentric and radially striated with more prominent striæ in posterior region. Dull grey-brown in colour or with black and white geometric patterns, particularly in young specimens on sandy beaches. Lunule present. Internal surface smooth with no crenulations as in *Protothaca staminea;* yellow in colour with deep purple at posterior end. Siphonal tip split.

Distribution.—Japan. Georgia Strait to California. British Columbia: Common in Georgia Strait; Barkley Sound; Jervis Inlet; Cortez Island; Esperanza Inlet.

Habitat.—Muddy gravel above half-tide level in Georgia Strait waters. There is little competition for space with native clams, which occur mainly at a lower tidal level.

Notes.—Imported accidentally with Japanese seed oysters. First noted in British Columbia in 1936 and erroneously described

as a new species (*Paphia bifurcata*). The Manila clam has increased rapidly in numbers and is now more abundant than the native little-neck. So far it has not spread northward beyond Georgia Strait; presumably cold water caused by turbulence in the northern tidal passages has acted as a barrier. However, it does occur in Barkley Sound and north to Esperanza Inlet on the west coast of Vancouver Island, presumably originating from Japanese oyster seed plantings.

Breeding occurs during summer but begins later than in the case of *Protothaca staminea*. The larvæ of the two species are difficult to differentiate (*see* Fig. 3). The Manila clam harbours the immature commensal pinnotherid crabs *Pinnixa faba* and *Pinnixa littoralis* in certain areas.

It is a very shallow burrower and appears to be susceptible to extremes of temperature; mortalities of considerable magnitude occur during severe winters. Growth rate is relatively slow, due no doubt to the relatively high tidal level it inhabits and to overcrowding. It is frequently found with a byssal attachment.

Formerly known as *Tapes philippinarum* Adams and Reeve, and as *Venerupis semidecussata* (Adams and Reeve).

***Saxidomus giganteus* (Deshayes)** **Butter Clam**

Description.—Size large, to 5 inches. Heavy solid shells, square to oval, latter particularly in young stages. Slight posterior gape, except in juveniles. External surface with prominent concentric striations and deep winter checks. Yellow in colour when young, changing to grey-white with age, but colour often affected by type of soil. Internal surface white, smooth but not glossy. Strong prominent external hinge ligament and pronounced umbones.

Distribution.—Aleutian Islands to California. British Columbia: Ladysmith, Victoria, Clayoquot Sound (Vancouver Island); Seal Island; Jervis Inlet; Alert Bay; Queen Charlotte Islands; Prince Rupert. Common.

Habitat.—Sand-gravel beaches mainly in lower third of tidal range, generally in well-protected beaches, occasionally in water 30 feet deep. If on exposed beaches, it tends to be stunted. Burrows to a depth of about 12 inches.

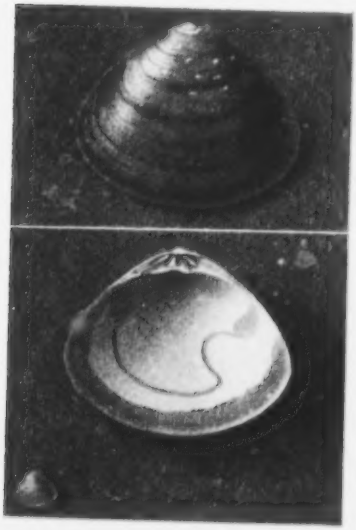
Notes.—This is the most important commercial clam in British Columbia, and in some years 3,000 tons have been produced.

Practically the whole production is used for canning. It is a summer breeder.

The butter clam at Seal Island, near Comox (a reserved experimental area), has been studied quite intensively since 1939; the last breeding large enough to produce a population of commercial size occurred in 1935. In most years there has been no spawning of consequence. Many of the clams still living on this beach (1959) are over 20 years old.

The mantle cavity of this species is occasionally inhabited by pinnotherid crabs (adult *Fabia subquadrata*, young *Pinnixa faba* and *Pinnixa littoralis*).

Transennella tantilla (Gould) **Little Transennella**



Description.—Size minute, to one-quarter inch. Shape elongated or oval. External surface smooth or with fine concentric grooves. White or yellowish in colour. Internal surface smooth, white with purple-brown at posterior end. Differs from *Psephidia* in having an anterior lateral tooth in left valve.

Distribution. — Alaska to Lower California. British Columbia: Victoria, Comox, Sooke, Clayoquot, Gordon Head (Vancouver Island); Burnaby Strait (Queen Charlotte Islands).

Habitat. — On sand-mud bottoms among surface weed and often in empty shells of other species. Intertidal to 20 fathoms.

Notes.—This is one of a number of species small in size in which development of eggs and young takes place in the mantle cavity. An investigation by Bent Hansen, of the University of Copenhagen, has shown that in *Transennella tantilla* all stages of development, from newly laid eggs to young ready to leave the mother, may occur in the same individual and number thirty to forty in all. His studies may be summarized as follows:—

1. When in the brood chamber the young are enclosed in a membrane until hatching, so they can neither take in food nor be fed by the parent.

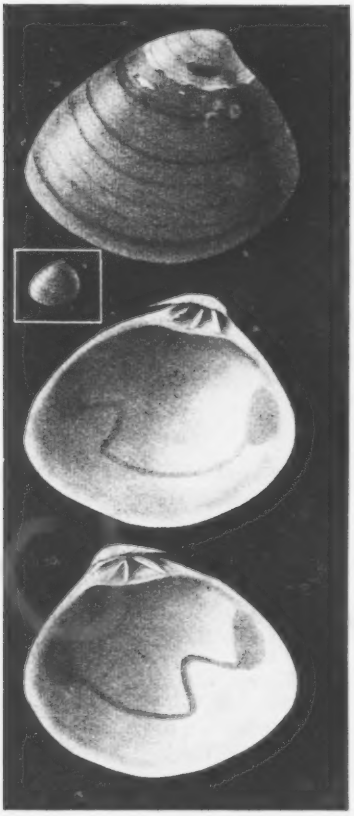
2. The brood is carried by the parent all during the year, but the young leave the mother only during the summer months.

3. The young appear to have no free-swimming stage, but settle down on the bottom immediately upon leaving the mother.

4. The species is supposed to live through only one winter.

5. There appears to be a degree of sex change from male to female, and most of the larger individuals were found to be female.

***Psephidia lordi* (Baird)** **Lord Pebble Shell**



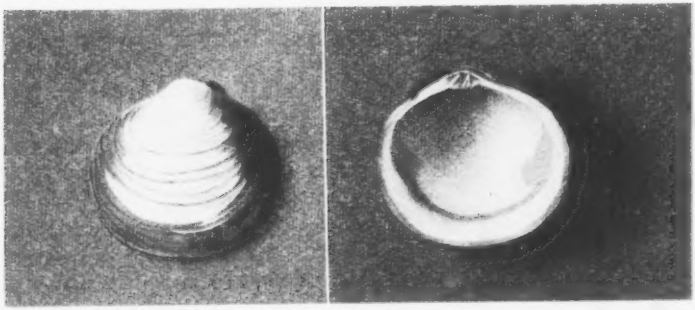
Description.—Size minute, to one-quarter inch. Shape triangular. External surface glossy, eroded in umbonal region. Very fine concentric striæ. White or olive in colour. Internal surface white, margin very finely crenulate under magnification. Prominent, centrally placed umbones. External ligament.

Distribution. — Alaska to Coronada Island (California). British Columbia: Comox, Ladysmith, Saanich Inlet, Clayoquot (Vancouver Island); Burnaby Strait (Queen Charlotte Islands); Gillies Bay.

Habitat.—Intertidal to 30 fathoms, in sand.

FAMILY UNGULINIDÆ

Shell sub-orbicular. Hinge with two bifid primary teeth. Marginal cartilage long.



***Diplodonta orbellus* Gould** **Round Diplodon**

Description.—Size small, to three-quarters of an inch. Shape globose. External surface with uneven concentric sculpture with thin brown periostracum. Internal surface dull and with no pallial sinus. Ligament external, prominent. Umbones central.

Distribution.—Bering Sea to Gulf of California. British Columbia: Departure Bay, Comox, Nahwitti Bar, Quatsino Sound (Vancouver Island); Egmont; Malaspina Inlet.

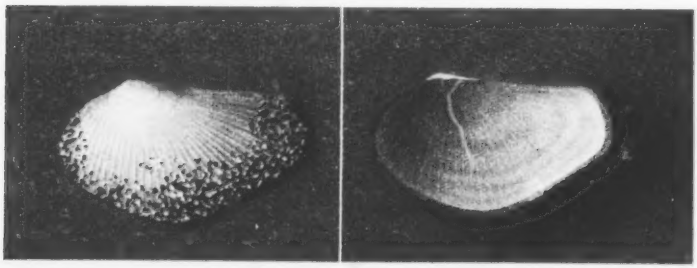
Habitat.—Intertidal to 20 fathoms.

Notes.—The foot in this small clam can extend four or five times the length of the shell and is used to form a mucus-lined tube to the surface which functions as an inhalant passage. There is a single posterior exhalant siphon of equal length.

Also known as *Taras orbellus* (Gould).

FAMILY LYONSIIDÆ

Shell inequivalve, oblong, nearly equilateral. Teeth usually absent, right valve more convex than left. Hinge with plate or ossicle covering internal ligament.



***Lyonsia pugettensis* Dall** **Puget Sound Lyonsia**

Description.—Size medium, to 1½ inches. Shape elongate, anterior end rounded, posterior extended and compressed. Thin, almost transparent silver-grey shell, slightly iridescent where not covered with adhering sand grains. Coarse concentric sculpture and well-defined radiating lines. Internal shell smooth, slightly iridescent, particularly in the thickened portions. No teeth. Umbones well to anterior and not prominent. Small ossicle under hinge.

Distribution.—Alaska to California. British Columbia: Ladysmith, Departure Bay (Vancouver Island); Lasqueti Island.

Habitat.—In sand.

***Entodesma saxicola* Baird** **Rock-dwelling Entodesma**

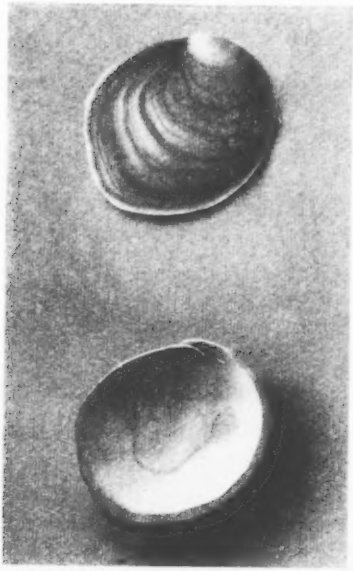
Description.—Size medium, to 6 inches. Shape oblong. External surface covered entirely with a thick olive-brown epidermis, which cracks when dry, often breaking the shell also. (The gaping posterior is extended by the periostracum.) Internally glossy and often iridescent. An ossicle covers the internal hinge. Umbones close to anterior end.

Distribution.—Aleutian Islands to Lower California. British Columbia: Victoria, Deep Cove, Clayoquot (Vancouver Island); Saltspring Island; Egmont; Port Neville; Beaver Harbour; Queen Charlotte Islands. Common.

Habitat.—Intertidal on shores of broken rocks. Lives among rocks in crevices but has been found attached to floats by a byssus. Adopts various shapes according to its habitat. Shell usually shatters as it dries out.

This mollusc is hermaphroditic, with external fertilization. Eggs and sperms are emitted alternately.

***Mytilimeria nuttalli* Conrad** **Sea Bottle Shell**



Description.—Size small, to 1 inch. Shell thin and fragile. Shape variable but generally circular. External surface quite smooth, white in colour under a thin yellow periostracum. Internal surface glossy white. Hinge ligament internal on a narrow ledge. Umbones sub-spiral. Anterior adductor scar much reduced.

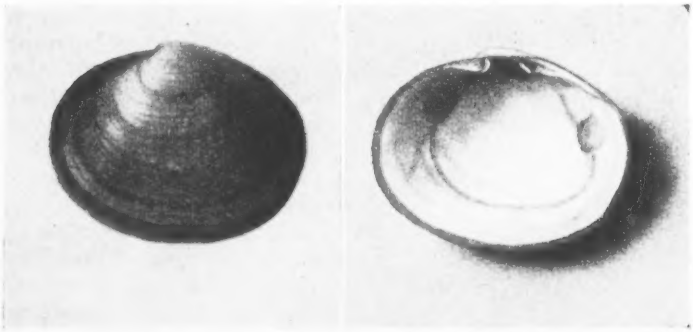
Distribution.—Alaska to Lower California. British Columbia: Comox, Victoria, Clayoquot Sound (Vancouver Island); Queen Charlotte Islands.

Habitat.—Intertidal to 20 fathoms, burrowing in compound ascidians (sea-squirts).

Notes.—The young clam appears to settle on the ascidian colony, which then grows up around it, leaving only a slit for the projection of the siphon. It is hermaphroditic.

FAMILY ERYCINIDÆ

Shell equivalve, inequilateral, thin, usually minute. Cartilage internal. Foot with byssus.



***Kellia laperousi* Deshayes** **LaPerouse Kelly Shell**

Description.—Size small, to 1 inch. Shells thin; shape circular to oval. External surface with uneven concentric sculpture and covered with olive-yellow periostracum, which may be eroded in umbonal area. Internal surface dull white in colour. Hinge ligament internal, hinge area between lateral teeth lacking, giving an appearance of being broken. Umbones small, central.

Distribution.—Bering Sea to California. British Columbia: Ladysmith, Hesquiat Harbour (Vancouver Island); False Narrows Reef; Egmont Reef. Common.

Habitat.—Intertidal to 35 fathoms. Often found inside empty shells of other species, but also in crevices or among mussels and oysters. Abundant on materials continually suspended above bottom. Attached by byssus threads.

Notes.—This species has a short inhalant siphon at the anterior end and a short exhalant siphon at the posterior end, which is quite different from the normal arrangement as found in the siphons of lamellibranchs.

ıntle cavity. Another species

The young are incubated in the man the Pacific Coast as well as (*Kellia suborbicularis*) also occurs on is larger and more oval in in Atlantic waters. *Kellia laperousi* i shape.

***Pseudopythina rugifera* (Carpenter)** **Rough Wrinkled Lepton**

Description.—Size small, to three-quarters of an inch. Shell fragile; kidney-shaped. External surface with rough irregular concentric lines, covered with yellow periostracum. Internal surface dull yellow-white in colour. Strong internal ligament. Umbones central, inconspicuous.

Distribution. — Alaska to Lower California. British Columbia: Ladysmith, Victoria.

Habitat.—Attached by byssus to the ventral surface of the abdomen of the sand shrimp (*Upogebia*) and to the sea mouse (*Aphrodite*).

Notes. — Professor G. E. MacGinitie has observed this species attach and detach itself at will. A specimen of *Pseudopythina* attached itself to the inside of one of the large claws of the red rock crab (*Cancer productus*) in the Provincial Shellfish Laboratory aquarium tank. It was carried about for some time and the crab made no effort to harm it, although it could have been reached by the other claw.

Another species, *Pseudopythina compressa,* is thinner (more compressed) and smoothly polished near the umbones.

Turtonia minuta Fabricius

Little Mullet Shell

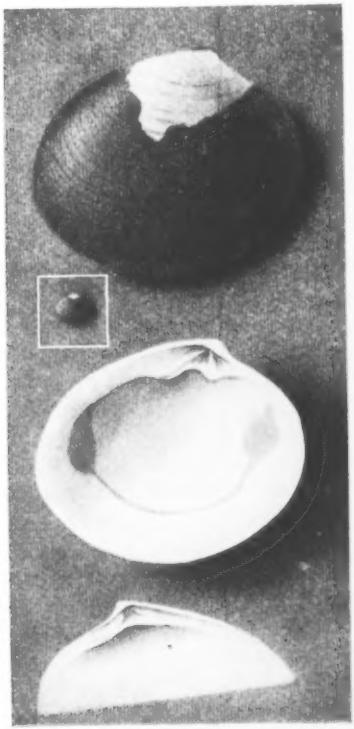
Description.—Size minute, less than one-eighth of an inch. Shape similar to that of young *Saxidomus.* External surface smooth except for extremely fine concentric lines. Purple in umbonal region. Internal surface smooth. Distinct broad pallial line. Umbones anterior and prominent. Hinge relatively long but not prominent.

Distribution.—Bering Strait to Lower California. Atlantic Ocean. British Columbia: Burnaby Narrows (Queen Charlotte Islands).

Habitat.—Nestling in tide pools in corralines (coral-like plants).

Mysella tumida (Carpenter)

Fat Pacific Lepton



Description. — Size small, to three-sixteenths of an inch. Shape triangular. External surface with light concentric sculpture and a dark-brown periostracum that may be eroded in umbonal region to show dull white shell. Internal surface glossy, iridescent blue-white in colour. Hinge internal. Umbones small near posterior end.

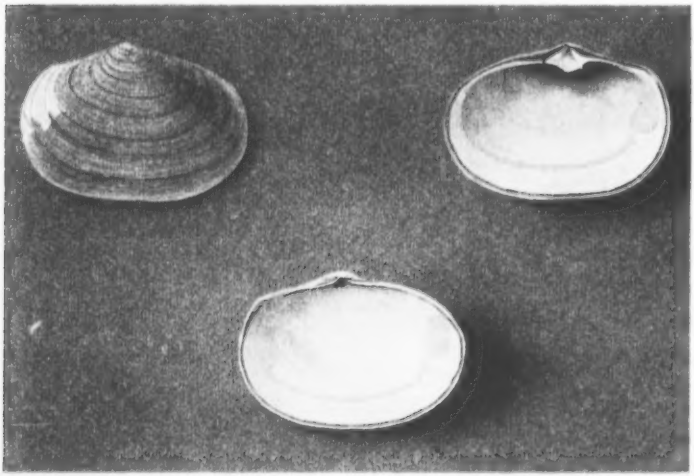
Distribution. — Alaska to California. British Columbia: Victoria, Comox, Clayoquot Sound (Vancouver Island).

Habitat.—Intertidal to 48 fathoms.

Notes. — Formerly known as *Rochefortia tumida* Carpenter.

Family MYIDÆ

Shell inequivalve, oblong, gaping widely at the posterior end. Pallial line broad and deeply sinuated. Muscle scars large and distinct. Ligament on a prominent shelf. Periostracum present.



***Cryptomya californica* (Conrad)** **False Mya, California Glass Mya**

Description.—Size small, to 1¼ inches. Shells fragile. Shape oval with posterior gape. External surface mostly with thin, dull reddish-brown periostracum and light concentric sculpture. Internal surface glossy white. Ligament internal, chondrophore in left valve. Umbones central and fairly prominent.

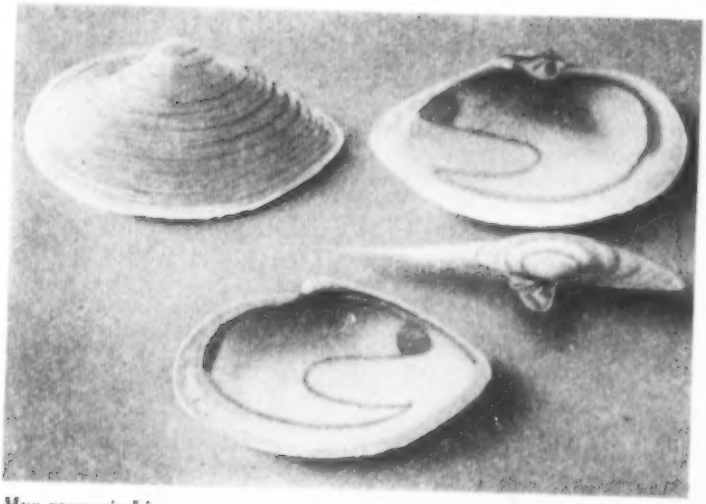
Distribution.—Alaska to Mexico. British Columbia: Victoria, Comox, Clayoquot Sound, Crofton (Vancouver Island); Boundary Bay; Thormanby Island (Queen Charlotte Islands).

Habitat.—In mud and sand to a depth of 20 inches. Intertidal to 50 fathoms (dead shells).

Notes.—Professor C. M. Yonge has studied this species. In spite of its short siphons and small size, *Cryptomya* lives quite deeply in the mud and for access to the surface its short siphons

penetrate burrows of other animals. The relatively large foot enables *Cryptomya* to burrow quite rapidly.

The gill area is relatively large, and great ciliary activity in feeding enables it to exist under conditions of a poor food-supply. Dead specimens are frequently found, particularly in estuaries.



Mya arenaria Linnaeus — **Mud Clam, Soft-shell Clam**

Description.—Size large, to 6 inches. Shell soft, easily broken. Shape elliptical with rounded anterior and narrow pointed posterior. Valves unequal. External surface with uneven concentric sculpture, white or grey in colour with thin yellow or brown periostracum, mainly at shell edges. Internal surface white in colour and characterized by a large spoon-shaped chondrophore in left valve. Internal hinge ligament. Umbones not prominent, slightly closer to anterior than posterior end.

Distribution.—Alaska-British Columbia boundary to California; North Atlantic. British Columbia: Masset Inlet, Naden Harbour (Queen Charlotte Islands); Work Channel; Prince Rupert; Rivers Inlet; Clayoquot Sound.

Habitat.—In British Columbia in sand and mud, mainly in estuaries at rather high tidal level.

Notes.—There appears to have been some doubt as to whether or not this species is native to the west coast of North America.

Available evidence indicates it was first introduced into the San Francisco Bay area in the last century and has since become distributed northward, partly by transplanting and partly by natural distribution. The spread from Puget Sound to at least as far north as Work Channel and the Queen Charlotte Islands by natural means has taken about fifty years.

It is much used as food on the Atlantic Coast.

Mya truncata Linnæus — **Blunt Soft-shell Clam, Truncate Soft-shell Clam**

Description.—Size medium, to 3 inches. Shape similar to *Mya arenaria* but has the appearance of being cut off sharply at posterior end, which gapes markedly. Valves unequal. External surface with rough concentric sculpture and a tough, papery epidermis, folding over edges of shell and extending past posterior end to form a sort of tube for the siphons. Colour grey-white. Internal surface quite glossy, light yellow in colour; chondrophore less cupped than that of *Mya arenaria*. Hinge ligament internal. Umbones moderately prominent, nearly central.

Distribution.—Arctic Ocean to Puget Sound; North Atlantic Ocean. British Columbia: Alert Bay; Victoria, Comox, Quatsino Sound (Vancouver Island); Discovery Passage; North Beach (Queen Charlotte Islands).

Habitat.—In fairly hard sand and mud.

Notes.—Not abundant.

Platydon cancellatus (Conrad)

Chubby Mya, Checked Soft-shell Clam

Description.—Size medium, to 3 inches. Shape rectangular, rounded posteriorly. Valves unequal. External surface with fine, even concentric sculpture, white in colour with thin, yellow-brown periostracum. Internal surface nacreous. Ligament internal with strong chondrophore in left valve. Sides of siphons armed with two pointed pads. Umbones near posterior and right umbo under the left.

Distribution.—Queen Charlotte Islands to California. British Columbia: Tlell (Queen Charlotte Islands).

Habitat.—Boring in soft rock or clay.

Notes.—Professor MacGinitie indicates that *Platydon* burrows may be distinguished from those of *Zirphæa* as the entrance of the burrows of the former is always sandy, while that of the latter is of mud or clay.

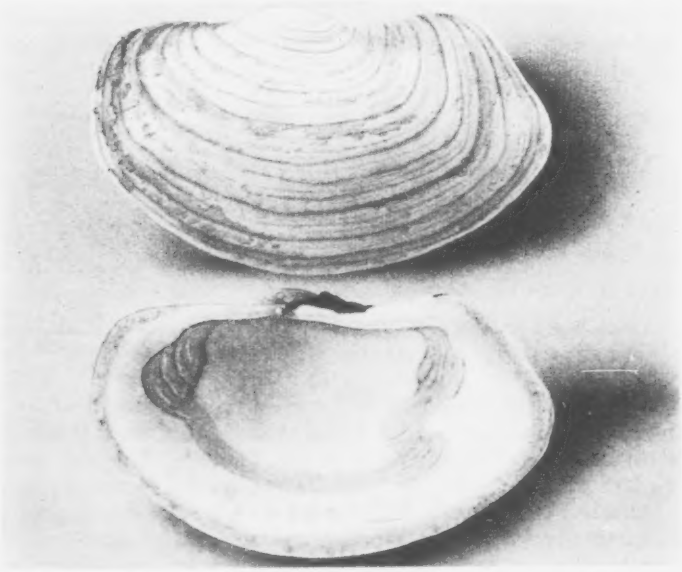
Professor C. M. Yonge has studied this species also; he considers it to be a *Mya* which has become adapted for burrowing into

soft rock. The species bores by shell movements directly into sandstone without the twisting that occurs in the burrowing action of most borers and the small foot appears to aid little or not at all in the boring action. The shape of the burrow is that of the cross-section of the shells with "dorsal" and "ventral" ridges, whereas most boring molluscs have a circular burrow.

Prior to 1941, when specimens were found at Tlell in the Queen Charlotte Islands, this species had not been taken north of the Strait of Juan de Fuca.

FAMILY HIATELLIDÆ

Shells nearly equivalve, gaping at posterior end. Hinge toothless or with two weak cardinals and ledge for support of external ligament. Deep pallial sinus, adductor scars conspicuous.



***Panope generosa* Gould** **Geoduck (Goo-ee-duck)**

Description.—Size large, to 9 inches. Shells heavy. Shape oblong, rounded anterior, truncate posterior, gaping except in dorsal-hinge area. External surface with rough concentric, sometimes broken sculpture. Colour grey-white with yellow periostracum. Internal surface dull white with coarse, deeply impressed muscle scars. Hinge external, small but prominent. Umbones small, central.

Distribution.—Alaska to Gulf of California. British Columbia: Sidney Spit; Ladysmith; Seal Island; Clayoquot; Burnaby Strait (Queen Charlotte Islands); Boat Harbour; Goose Island.

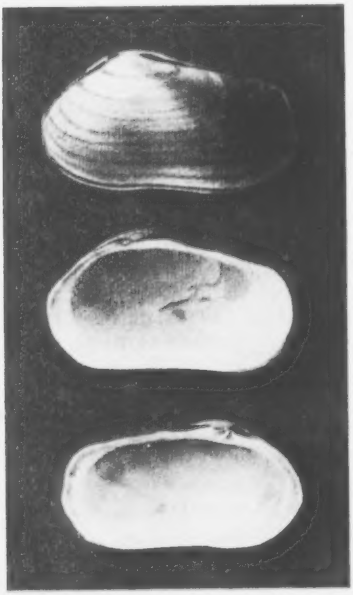
Habitat.—Sand and mud beaches in protected bays. Down to 3 feet below surface. Intertidal to deep water.

Notes.—Presumably because geoducks live so deeply in sand, shells of this species are not frequently found. The large siphons cannot be retracted within the shells but are able to extend up to a distance of about 3 feet to the surface. Since the species occurs so far below the surface, a considerable digging effort is required to obtain a specimen. The siphonal tip of a geoduck may be distinguished from that of a horse clam by the fact that the former has neither tentacles nor pads, and is light brown in colour. The horse clam has chitinous pads on the siphonal tips, is dark green or black in colour, and the inner edge of each siphon is fringed with tentacles.

The sexes are separate, and spawning usually takes place once a year in late April or early May. The name "geoduck" or "gueduc" is said to derive from the Nisqually (Indian) phrase for "dig deep."

The meat is edible but may be improved by mincing. The siphons and foot should be skinned before use.

Hiatella gallicana (Lamarck) **Gallic Saxicave**



Description. — Size small, to 1 inch. Shells thin. Shape oblong, very irregular, depending on environment. External surface uneven with rough concentric striation. There is a row of spines along the dorsolateral edge of each shell in young specimens, but they are usually worn away in older animals. Colour dull greywhite where the olive-brown periostracum has been eroded. Internal surface dull white with discontinuous pallial line. Two teeth in young, none in adult. Hinge ligament external. Umbones near anterior end.

Distribution. — Arctic Ocean to Panama; also on both coasts of the Atlantic Ocean. British Columbia: Saltspring Island; Departure Bay; Ladysmith; Comox; Quatsino. Common.

Habitat.—Burrows in soft rock or nestles in a wide variety of places, such as in kelp holdfasts. Intertidal to deep water.

Notes.—Dr. W. Russell Hunter, of Glasgow University, has found *Hiatella* will bore only if it settles on the smooth surface of soft homogeneous rock, while if it settles on a hard, creviced rock surface, it will become a byssally attached non-boring adult. He also found that adult *Hiatella* bore by mechanical action of the valves alone.

There are varied opinions among taxonomists regarding speciation in this genus, which is better known as *Saxicava.*

***Hiatella pholadis* (Linnæus)**

Nestling Saxicave

Description.—Size medium, / 2 inches. Shape oblong, ir- to 2gular. External surface rather regnooth, slightly wrinkled. Insmernal surface smooth, chalky ternth interrupted pallial line. withinge external, umbones near Hinterior end.

ante *Distribution.* — Arctic :ean to Panama. Both coasts Oce the Atlantic Ocean. British of tblumbia: Valdes Island; False Colurrows.

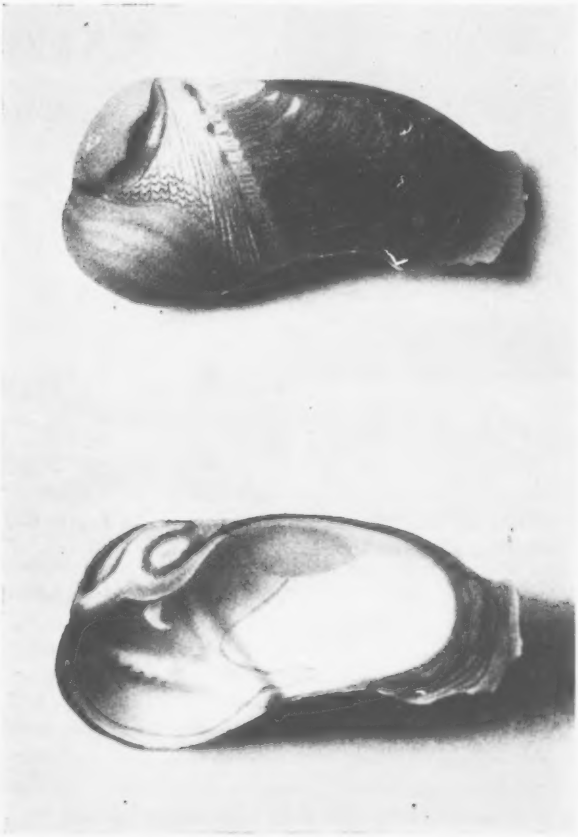
Nar *Habitat.* — In British Co- nbia found mainly in burlumws of pholads. Intertidal to rowep water.

deepassociated with this species

Notes.—No larvæ that might be asia, adults occur only in the have been found. In British Columbia*rphæa*, in slate. The large empty burrows of *Pholadidea* and *Zir**Hiatella gallicana* (*H. arctica*) size of these is striking for the normal *Hi* length. It is cor sidered by found nestling seldom reaches 1 inch in lts of two forms. some authorities that the species consists

FAMILY PHOLADIDÆ

Shell gaping at both ends without hinge or ligament. Anterior gape closed in adult. With accessory dorsal pieces and a transverse furrow. Internal myophore projecting from umbonal cavity.



Penitella penita **(Conrad)** **Piddock**

Description.—Size medium, to 3 inches. Bulbous anterior, rounded posterior. External surface divided into several distinct areas. Posterior area, occupying more than half the shell, has concentric markings with a grey or brown periostracum which may be extended beyond shell area. A groove separates this area from a triangular median section which carries abrasive teeth and both radial and concentric striæ. Ventral and anterior to this is a thin shell membrane which is presumably secreted after the animal has completed its boring activities. The ventral margins are continuous with each other. Internal surface shows three shell divisions and a prominent myophore occasionally with a spoon-shaped tip. Hinge covered with a triangular plate. Umbones not prominent. Only a dorsal articulating area. Siphons smooth. Ends enclosed by two heavy chitinous pads.

Distribution.—Alaska to California. British Columbia: Comox; Ladysmith Harbour; Victoria; Valdes Island; Pender Island; Hornby Island; Vesuvius Bay; Lasqueti Island; False Narrows; Yakun Point (Graham Island, Queen Charlotte Islands). Common.

Habitat.—In slate, soft rock, hard clay, and lignite.

Notes.—Formerly known as *Pholadidea penita* Conrad.

***Penitella gabbi* Tryon**

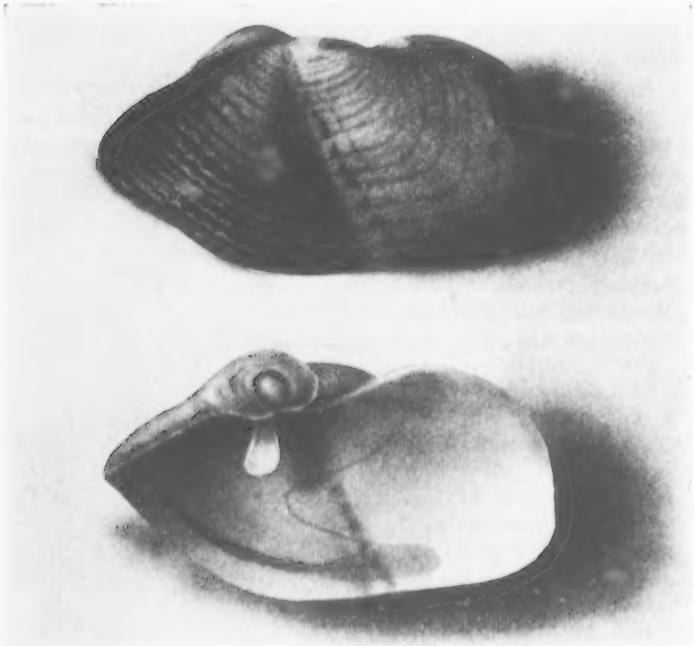
Oval Piddock, Wart-necked Piddock

Description.—Size medium, to 3 inches. Shells solid. Shape oval. External surface with a posterior area concentrically marked with grey-brown periostracum. A groove separates this area from the central area with its teeth and radial and concentric striations. A large shiny callus anterior and dorsal to the latter area. Internally, ventral margins meet only in the centre and with hinge area provides a second articulating area. The prominent myophore is knobbed at the end. Siphons white and irregularly covered with pustules. No chitinous pads as on *Penitella penita*, which has no pustules.

Distribution.—Bering Sea to Gulf of California. British Columbia: Victoria; Valdes Island; Tow Hill (Queen Charlotte Islands).

Habitat.—Boring into fairly solid rock and also into hard clay.

Notes.—Formerly known as *Pholadidea ovoidea* Gould.



***Zirphæa pilsbryi* Lowe** **Pilsbry Piddock**

Description.—Size large, to 6 inches. Shells solid. Shape elongate, gaping widely at both ends with anterior ventral area cut away. External surface with two main areas divided by an oblique groove. Coarse concentric markings and anterior ventral edge with spines and teeth. Internal surface chalky white with muscle scars well defined. Myophore with rounded end. Only a dorsal articulating area. Part of siphon covered with dark periostracum of shell. Remainder with no periostracum but speckled with small orange-coloured spots.

Distribution.—Bering Sea to California. British Columbia: Cordova Bay, Gordon Head (Vancouver Island); Valdes Island; Pender Island; Cumshewa (Queen Charlotte Islands).

Habitat.—Boring into shale and clay. Intertidal to deep water.

Notes.—This is one of the few species of burrowing clams that is able to live for long periods out of its burrow. One specimen held in a submerged tray in Ladysmith Harbour was still alive after eleven months. Professor MacGinitie has described the boring movements of this species by observing specimens placed in glass tubing.

Unlike pholads and shipworms (*Bankia*), *Zirphæa* continues active boring throughout its life.

Formerly known as *Zirphæa gabbi* Tryon.

Family TEREDINIDÆ

Shell small, deeply notched. Myophore internal. Body wormlike; siphons separate, protected by calcareous pallets.

***Bankia setacea* Tryon** **Northwest Shipworm**

Description.—Size to 3 feet in length, three-quarters of an inch in diameter. Shape wormlike with naked body, except for small shells enclosing anterior region. External surface of shells composed of three sections, the anterior bearing cutting-teeth. Posterior end of body carries two feather-like calcareous structures, the pallets. Internally, two round articulating surfaces of the shell are evident, together with a long, blade-like myophore. Hinge as such lacking.

Distribution.—Bering Sea to Gulf of California. British Columbia: Common everywhere along the coast.

Habitat.—Found only boring into wood. Intertidal to 50 fathoms.

Notes.—This animal is found only burrowing into wood, which it may completely destroy. Shipworms breed like other lamelli-

branchs, but for survival larvæ must come in contact with a wooden object when time for settlement arrives. The larva is then one-quarter mm. long (*see* Fig. 2). With teeth that are developed along the shell margin, it begins to burrow into wood. Once inside it normally follows the grain. Attachment is maintained at the burrow entrance, and as the animal grows the two shells move away at the head of the burrow. Boring is done by the toothed shells, which rasp away wood by a flaring action. As with many lamellibranchs, shipworms are equipped with siphons for water transport. These are extended outside the burrow but may be withdrawn completely. In addition, the feather-like pallets are protective mechanisms which are able to stop up the burrow entrance. Part of the raspings is used as food, although plankton is also utilized. Unused material is discharged through the exhalant siphon. The adult may grow to a length of 3 feet.

This borer is often referred to as " teredo," since the common Atlantic species belongs to the genus *Teredo*.

For further details concerning development, rate of growth, and control methods *see* " The British Columbia Shipworm," by D. B. Quayle, Report, B.C. Dept. of Fisheries, 1955.

ACKNOWLEDGMENT

Dr. G. C. Carl, Director of the Provincial Museum, assisted in the preparation of this handbook in many ways. Mrs. L. M. Griffith, of Egmont, kindly examined the manuscript and provided specimens. Mrs. G. C. Carl provided much of the data on pinnotherid commensals.

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REGULATIONS

The current regulations governing the taking of shellfish (molluscs) in British Columbia waters are as follows:—

Abalone

No person shall fish for, catch, buy, sell, or have in possession any abalone that measures less than two and one-half (2½) inches across the shortest diameter of the shell.

Clams

(1) No person shall dig for or take, have in possession, buy, sell or attempt to sell any razor clam that measures less than three and one-half (3½) inches, and any butter clam that measures less than two and one-half (2½) inches, any little-neck clam (*Venerupis*) that measures less than one and one-half (1½) inches across (that is, through) the longest diameter of the shell.

(2) Subject to the provisions of subsection (4), no person shall dig for or take, have in possession, buy, sell, or attempt to sell or export any fresh or live butter or little-neck clams or mussels from June 1st to October 31st in each year, both days inclusive.

(3) No person shall dig for or take any razor clams from July 1st to October 31st in each year, both days inclusive.

(4) The Area Director may prohibit digging for or taking clams in any area or areas at an earlier date than the beginning of the close times should he deem such to be necessary, and he may permit digging for or taking of a sufficient quantity of razor clams in District No. 2 during the close season to meet the bait requirements of the crab fishery.

(5) No person shall fish for or take clams of any variety from Seal Island in the vicinity of Comox until the 1st day of January, 1960, except for experimental purposes with the consent of the Minister of Recreation and Conservation for British Columbia.

(6) No person shall use any mechanical digger, apparatus, or dredge for the purpose of taking any species of clams.

(7) No person shall dig for or take clams, mussels, or oysters of any variety from Nanaimo Harbour, Exit Channel, and adjacent

waters lying inside or south of a straight line from Pimbury Point, through Newcastle and Protection Islands, to Jack Point.

Oysters

Except by special permission of the Minister of Recreation and Conservation for the Province of British Columbia, no one shall plant or introduce into an oyster-bed any oyster or oyster seed not produced in the Province.

GLOSSARY OF TERMS

Adductor muscle—muscle attached to each shell of bivalves and which draws the shells together when it contracts. Impressions left on the shell in the region of attachment are called "scars."

Aragonite—a crystalline form of calcium carbonate.

Bivalve—having two valves or shells.

Byssus—thread secreted by certain molluscs such as mussels serving to attach them to the substratum.

Callus—a thickening of the shell.

Cardinal tooth—a hinge tooth of a bivalve shell located just below the umbone.

Chondrophore—a type of resilifer.

Cilia—microscopic hair-like structures, capable of beating and creating a water current.

Compressed—flattened.

Compound ascidian—a colony of soft bodied marine animals that cling to rock surfaces.

Concentric—having the same centre.

Copepod—a small, normally free-swimming, crustacean.

Crenulate—an edge or margin regularly notched or grooved.

Ctenidia—gill-like structure of molluscs.

Dorsal—toward the back or hinge line.

Epithelium—thin layer of cells which lines certain tissues.

Equivalve—shells equal in size and shape.

Family—in classification, a group of genera.

Genus—in classification, a group of closely related species.

Globose—nearly spherical in shape.

Hermaphrodite—with both male and female reproductive organs.

Heterodont—one or more hinge teeth with cardinals projecting from the umbonal area and laterals, if present, outside this area.

Hinge ligament—a spring-like structure joining the dorsal edges of bivalve shells.

Inequivalve—valves unequal in shape or size.

Inequilateral—beak not midway between anterior and posterior ends.

Inflated—expanded, opposite to compressed.
Labial palps—sense organs near the mouth.
Lamellibranch—a mollusc having lamella or plate-like ctenidia.
Larva—a young stage of certain animals before the adult form is reached.
Lateral teeth—hinge teeth located to the sides of the umbone.
Lithodesma—an accessory shelly plate below the hinge.
Lunule—a heart-shaped depression in front of and close to the umbones.
Mantle—a thin envelope of tissue enclosing the body of molluscs.
Myophore—a long curved process emerging from the umbonal pit and used for muscle attachment.
Nacre—the inner layer of shell (" mother of pearl ").
Nemertean—a non-segmented marine worm.
Orbicular—with a circular outline.
Ossicle—a calcareous plate.
Otocyst—organ for maintaining equilibrium.
Ova—eggs.
Oviparous — laying eggs instead of bringing forth fully formed young.
Larviparous—producing formed larvæ, rather than ova.
Pallet—calcareous feather-like structures of shipworms.
Pallial line—line or depression on the shell along which the mantle is attached.
Pallial sinus—notch in the pallial line marking the region of attachment of the retractor muscles of the siphon.
Pericardial—surrounding the heart.
Periostracum—the thin outer layer of molluscan shells.
Radula—a ribbon studded with teeth. Found in gastropods as a tongue-like rasping organ.
Resilium—an internal elastic hinge ligament which is compressed as the shell closes.
Resilifer—the process or pit into which the resilium fits; also termed " chondrophore."
Sinuate—curved in and out.
Species—a group of closely allied animals or plants.
Striæ—fine ridges or furrows.

Taxodont—a hinge with teeth more or less similar in shape arranged in a series on each side of a point below the umbones.
Taxonomy—the science of classification
Umbone—the projection of the shell close to the hinge on bivalve molluscs; also termed " umbo " or " beak."
Velum—in larvæ, a protrusible platform studded with cilia. Serves as a swimming organ.
Ventral—the lower side of the body opposite the hinge line.
Viviparous—producing live young.

GLOSSARY OF APPROXIMATE MEANINGS OF SCIENTIFIC NAMES

arenaria—sandy.
bodegensis—Russian Bodegas (type locality).
californianus—of California.
californica—of California.
cancellatus—latticed.
capax—roomy, spacious.
carpenteri—after P. P. Carpenter, a noted molluscan taxonomist.
Crassostrea—thick oyster.
Cryptomya—hidden mya.
edulis—edible.
Entodesma—ligament within.
falcata—hook-shaped.
flabellatus—fan-like.
gallicana—French.
generosa—created.
giganteus—large.
gigas—large.
Hiatella—small cleft.
Hinnites—hinny-mule (because of tenacious attachment).
lordi—after J. K. Lord, naturalist on the British North American Boundary Commission.
lurida—pale yellow.
macroschisma—long split.
minuta—tiny.
multirugosus—much wrinkled.

Mya—a sea mussel.
Mytilus—mussel.
nasuta—pertaining to the nose.
nuttalli—after Thomas Nuttall, a noted biologist.
orbellus—round.
Panope—sea-nymph.
patula—open.
Psephidia—pebble.
pholadis—lurking in a hole.
pilsbryi—after H. A. Pilsbry, an eminent conchologist.
Platydon—flat tooth.
Pododesmus—fettered foot.
rubropicta—painted red.
rugifera—wrinkled.
salmonea—salmon-coloured.
Schizothærus—split hinge.
saxicola—rock dwelling.
Saxidomus—rock house.
secta—cleft.
Semele—daughter of Cadmus and Hermione.
semidecussata—half divided.
setacea—brittle.
sicarius—assassin.
Siliqua—pod.
Solen—channel-pipe.
staminea—thread.
subobsoleta—somewhat worn.
tantilla—so little.
Taras—son of Neptune.
Tellina—a kind of mollusc.
tenerrima—most delicate.
Transennella—tiny trap.
truncata—shortened.
tumida—swollen.
Venerupis—rock.
virginica—of Virginia.
Volsella—pincers.

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